The FOUNDRY

Volume 57
Number 20

Published
Semimonthly

CLEVELAND, OHIO, OCTOBER 15, 1929

Cast Signs Add Dignity To Many Buildings

SIGNS! The country seems flooded with them. Along the highways and byways and throughout the throbbing metropolis, a variety of signs, big ones, little ones and middle sized ones, tell the story of this or that product or service. While the use of signs seems to have reached the ultimate in extremes in the past ten years,

Bronze Sign on One of Cleveland's Early Banks

that medium of display is by no means new. The ancient Greeks and Romans made use of signs for various purposes. The blazed trail of the Indian was a street of signs. In darkest Africa, cast plaques over doors of huts remain as relics of forgotten tribes who possessed an art unknown to the black men of today. All kinds of signs were used to some extent, through the ages, but it seems that the men of early civilization held a great preference for bronze. In many respects that favoritism has been carried through the ages to the present days. Where dignity, richness, and an appeal to the artistic sense are desired, bronze has been found highly desireable. Banks, retail stores, office buildings, factories, and public buildings may be included among the many users of bronze signs. Of course, these signs are made in the foundry. They are hand crafted by super artisans and may be made in any size, shape or form to meet the special requirements of the user.

Find Where Castings Can Be Sold

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PUBLISHED BY THE PENTON PUBLISHING CO., CLEVELAND, O.
BRANCH OFFICES

CHICAGO ..... 1347 Peoples Gas Bldg.
CINCINNATI ..... 209 Edwards Bldg.
NEW YORK ..... 2203-2206 No. 220 Broadway
PITTSBURGH ..... 2148-49 Oliver Bldg.
SAN FRANCISCO ..... 24 California Street
WASHINGTON, D. C. ..... 1653 Pennsylvania Avenue
LONDON, ENGLAND ..... 416-417 Caxton House, Westminster, S. W. 1
BIRMINGHAM, ENGLAND ..... 14 New Street
PARIS, FRANCE ..... No. 9 Rue de Londres
BERLIN, GERMANY ..... Dahlmerstrasse 64A, Berlin Lichterfeld-West

Cable address, IROTRAPEN, London

SUBSCRIPTION

United States and Mexico ..... $3.00 a year
Canada ..... $4.00 a year
Great Britain and other Foreign Countries ..... £1:0:0 a year
Single Copies ..... 25 cents

Copies published three months or more previous to date of current issue, 50 cents each.

Member, Audit Bureau of Circulations, Associated Business Papers Inc., National Publishers' Association

The A. B. P. is a nonprofit organization whose members have pledged themselves to a working code of practice in which the interests of the men of American industry, trade and professions are placed first—a code demanding unbiased editorial pages, classified and verified subscribers, and honest advertising of dependable products

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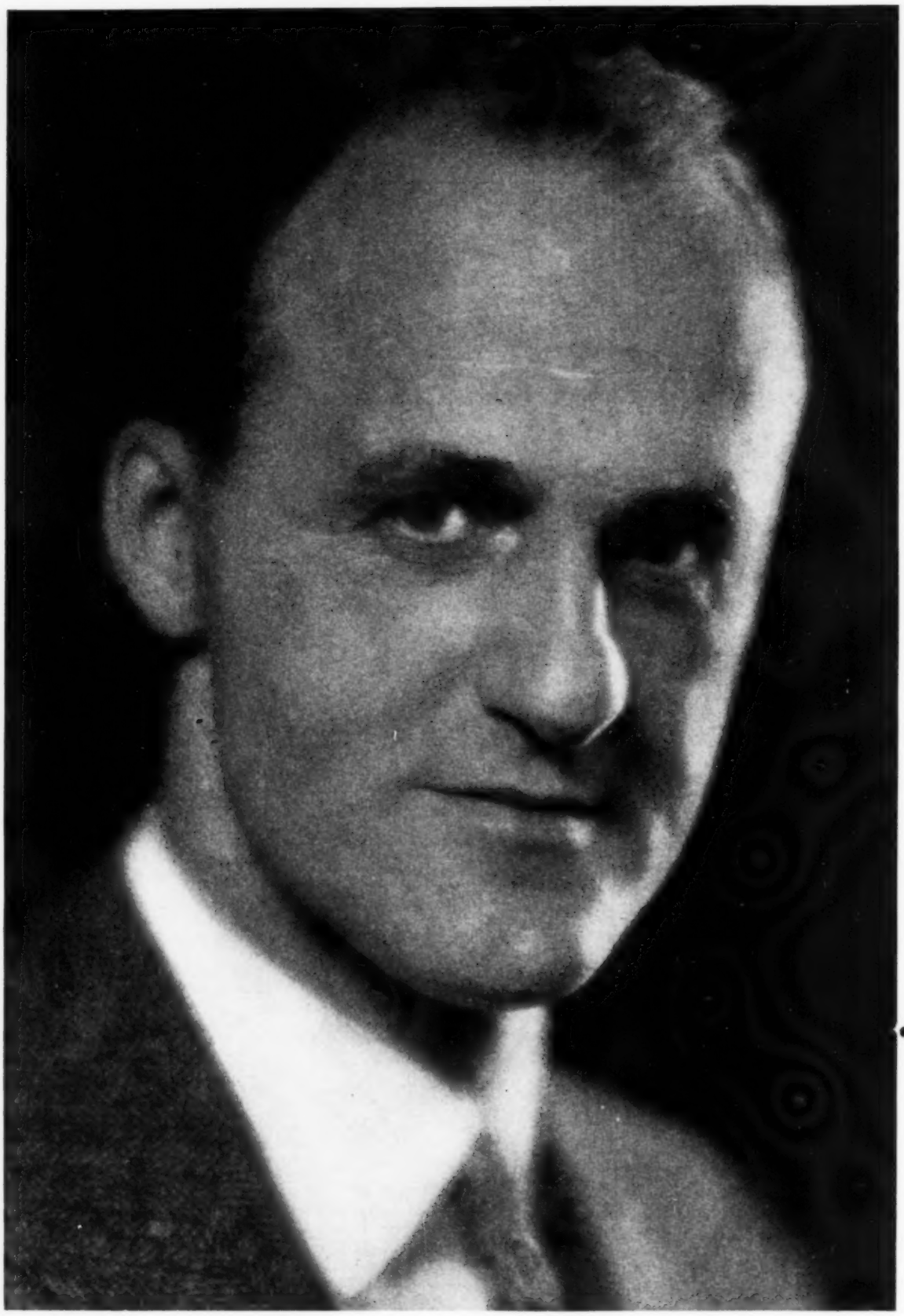


1886 H. Cole Estep 1929

H. Cole Estep, Publisher and Foundry Leader, Is Dead

H. COLE ESTEP, aged 43, vice president, the Penton Publishing Co., Cleveland, and for the past 20 years prominently identified with the foundry industry through his writing, speaking and publishing activities, died suddenly, Monday, Sept. 30, at Cleveland, of heart failure.

Mr. Estep ranked high among publishers of business, technical and industrial publications. He was an engineer of recognized standing, an authority on many phases of ship construction and operation and a leader of thought in the foundry industry.

His interest centered in foundry technique and management and through his connection with THE FOUNDRY and his activity in the various technical and trade associations he contributed largely to the advancement of the industry throughout the world. He contributed papers to the American Foundrymen's association, was editor of the *Transactions* of that society for a number of years and as chairman of the papers committee he exhibited a keen insight into the needs of foundrymen and assisted in furthering the work of improving technical and scientific practice. He was elected a director of the association in recognition of this work.

Perhaps his greatest single contribution to the foundry industry of the world was through the promotion of a system of exchange papers between the foundry technical societies of America and Europe, which led to the triennial meeting of world foundrymen at the International Foundrymen's congresses, the third of which was held in London in June, 1929. He was chairman of the American Foundrymen's association committee on international relations and exercised a profound influence in the work of bringing international amity through a confidence born of understanding.

Mr. Estep was born at Stampede Tunnel, Wash., Sept. 27, 1886. He was educated in the public schools and at the University of Minnesota from which he was graduated in 1908, with the degree of mechanical engineer. He previously had been employed in the engineering department of the Northern Pacific railway but immediately after graduating he became affiliated with the editorial staff of the Penton Publishing Co., Cleveland. He represented the interests of the company at Seattle until 1910 and then was transferred to Chicago. He was in charge of editorial work there from 1910 until 1914. In that latter year he was transferred to Cleveland as associate editor of THE FOUNDRY and engineering editor of *Iron Trade Review*, serving in those capacities until 1917. In 1915 he also assumed additional duties as editor of *Marine Review*, serving until 1919. During 1918 and 1919, he also filled the office of editorial director of the Penton Publishing Co.

Immediately after the World war, Mr. Estep was sent to England as European manager, where he established the Penton Publishing Co. Ltd., inaugurating a European organization, with headquarters at Caxton House, Westminster, S. W. 1, London; and with branch offices in Paris, France and Berlin, Germany and representatives in other countries. He remained until 1924, when he returned to Cleveland, assuming his executive duties there as vice president. During those years, he also was identified with all of the Penton publications.

He was a director of the American Foundrymen's association, of which he had been a member since 1914. He was secretary of the Foundry Equipment Manufacturers' association, member of the American Iron and Steel institute, American Society of Mechanical Engineers, British Iron and Steel institute, Institute of British Foundrymen, and the Association Technique de Fonderie de France. He also was a member of the Engineers' club of London, England, numerous social and business organizations, and honorary fraternities.

Doubles Production with New Foundry Layout

By E. C. Kreutzberg

LAST year the Treadwell Engineering Co., Easton, Pa., manufacturer of steel works, rolling mill and special machinery, encountered some difficulty due to the fact that its steel casting department was not able to produce castings in large enough volume to keep pace with the production in its machine shops. It appeared for a time that the company might have to go to the expense of erecting an addition to its steel foundry, but a decision on this point was deferred pending an investigation as to the full production possibilities of the existing foundry.

A careful study was conducted over a period of months. Copies were made of the floor plan of the building, and the lines of travel of the castings were indicated thereon. These lines, denoting the travel from the pattern to the shipping stages of the castings, were plotted to scale in colors. Then a study was made, after a checkerboard fashion, to determine what short-cuts could be effected. As one layout after another was made, the possibilities of straight-line production methods grew more surprising. The management ultimately decided on a layout which was put into execution in the spring of 1929.

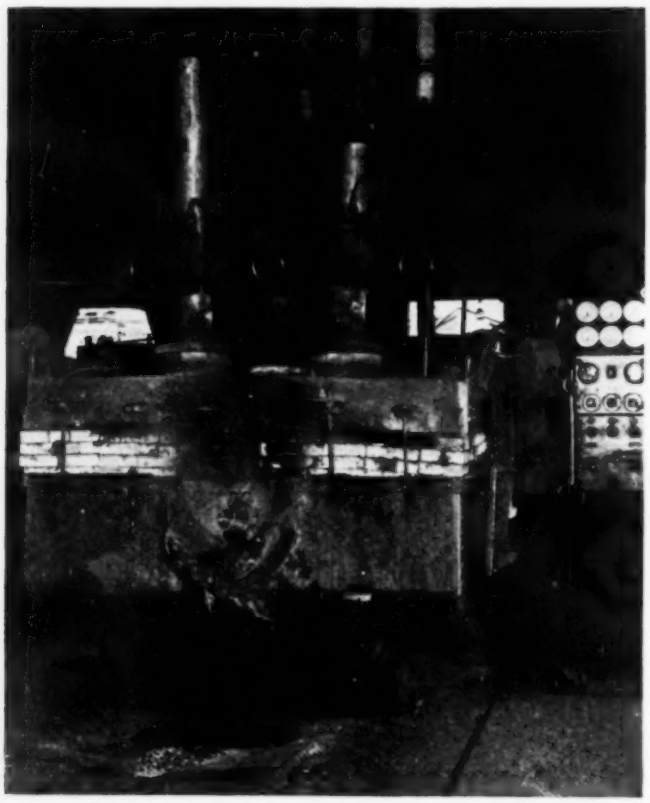


Fig. 1—The First Heroult Furnace To Be Installed in the United States for the Commercial Production of Castings

In brief, the company has doubled its production of steel castings without adding any floor space. The melt has been increased from 250 tons to substantially 500 tons per month. It has accomplished this result entirely by the application of straight-line production methods. The small castings, weighing up to 150 pounds, now travel an average distance of 365 linear feet, whereas formerly the line of travel for these castings stretched out 1155 feet. Adoption of the present scheme, while not entailing any additional floor space, did entail an extensive rearrangement of the equipment in the foundry, and the installation of considerable new equipment.

Steel castings made at the Treadwell foundry range in weight from 1 pound to about 4 tons. Those weighing 150 pounds or less are classed in the small castings group. The steel foundry, 140 x 220 feet, includes a 70-foot main bay and two 35-foot side bays. The main bay is spanned by two 10-ton overhead traveling cranes. Under the old arrangement, the machine and bench molding floors were located at the south end of the main bay, in a space beyond the travel of the overhead cranes. These molds, to be poured, had to be carried out into the portion of the bay that was commanded by the cranes. The method of pouring them was by means of a bottom-pour crane ladle.

The plan for reallocating the floor space called for the location of the machine and bench molders in the west bay. The latter then was occupied in various ways. It contained the small core department, sandblast sand storage, molding sand and core storage, a flask storage and an accumulation of broken flasks the other materials that usually fill up dead space in every foundry. The

Fig. 2 (Below)—Hot Metal Is Brought into the West Bay on a Roller Bearing Truck Which Runs on a Narrow Gage Track. Fig. 3 (Right)—General View of Small Castings Department Located in the West Bay

broken flasks and much of the other material were found to be simply junk. After reclaiming as much of it as possible, the rest was thrown out on the dump. The problems, what to do with the small core department, the flask storage and the sandblast sand and foundry sand storage were worked out in an interesting manner.

The company in recent years had been getting away from dry sand molding to a large extent and this assisted materially in making it possible to find another space for the small core department. Four large drying ovens were located in the east bay. Owing to the more general adoption of green-sand molding, it was found possible to scrap two of these drying ovens. The other two ovens, somewhat obsolete, were coal fired from large fireboxes. They were converted to the use of oil fuel, thus permitting the removal of the old fireboxes. Furthermore, the change to oil eliminated the coal piles which had been occupying considerable floor space. Thus considerable space was made available in the east bay which now is occupied by the department making small cores formerly located in the west bay.

At the same time that the department for small cores was moved, a piece of equipment was scrapped which had been occupying needless space in the west bay. This was a core drying oven of the coal fired type. In relocating the core department, the company installed an electric drying oven of the most modern type. This oven occupies a small amount of floor space with a large drying capacity. With this oven the company claims to have experienced much better results than with the old coal-fired oven. The operation of the electric oven is uniform. The temperature can be controlled within one degree. Not one core has been burned in this oven during the six months it has been in operation. Incidentally, the saving in labor of one man, formerly employed in firing the coal and removing the ashes, practically offsets the increased heating cost resulting from the use of electricity.

In clearing the west bay, a much more efficient method of storing sand and other materials was developed. Formerly, a considerable amount of space in the east bay had been occupied by ferromanganese, ferrosilicon and other materials packed in barrels or piled on the floor. A number of concrete bins were constructed in this space. Some of these bins now are devoted to storage of molding sand and sandblast sand, formerly stored in heaps in the west bay. The other bins are employed for storing ferromanganese, ferrosilicon and other materials. The concrete bins, in addition to saving the floor space, make possible a great saving in another direction; the various materials can be taken now in carload lots,

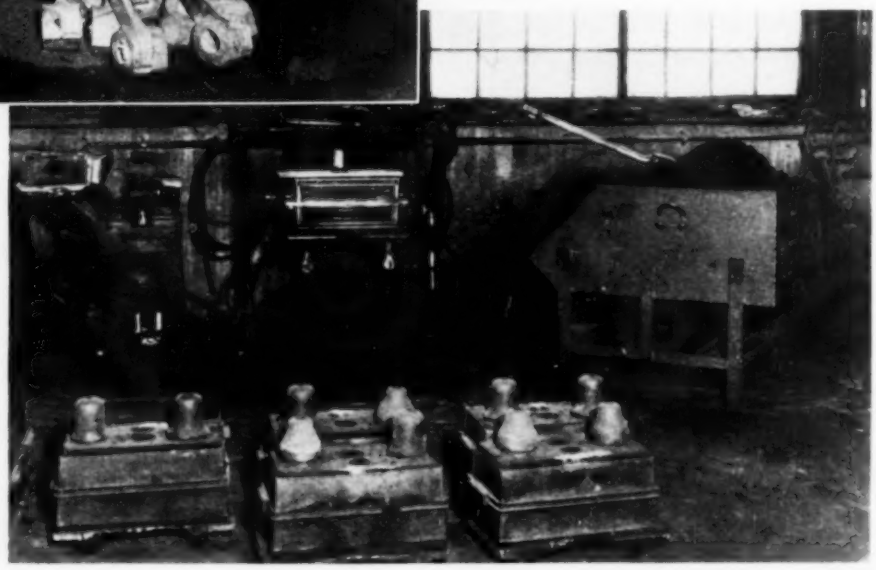


Fig. 4 (Above)—A High Speed Type Grinder Has Supplanted Four Machines Operating at Lower Speeds. Fig. 5 (Right)—Facing Sand Is Delivered to the Bench and Machine Molders in Special Boxes

thus eliminating the extra costs incidental to crating and barrelling small lots.

A small portion of the west bay floor space had been occupied by the old sandblast room, which extended from the main bay into the west bay. Cars loaded with castings were pulled by the crane into the sandblast room from the main bay. They were removed from the opening in the west bay by car movers. This sandblast room had no sand-reclaiming feature and its operation was costly. The equipment was scrapped and replaced by a modern sandblast chamber, with a sand-reclaiming system. It lies entirely in the main bay, occupying space under the crane cabs not available for molding. The new sandblast room has a door at each end and is provided with two trucks, mounted on tracks. They are equipped with ball bearings, so that they can be moved easily by hand. Loading and unloading of the trucks is done at both ends of the sandblast chamber; while one carload is being blasted, the other car is being prepared to be pushed into the chamber. Savings in man power, crane time and in reclaimed sand have been affected, it is stated, by the installation of this new sandblast unit.

When the west bay had been cleaned, the machine and bench molders were installed in the south end of that bay. The entire molding floor was concreted, giving a good, level setting for the molds and making it easier to keep the foundry clean. The molds are poured from hand-ladles, on the molding floor, thus preventing waste of time and space formerly incurred in moving the molds to where they could be poured from bottom-pour crane ladles. Elimination of bottom pouring has eliminated trouble due to breaking out of molds, cutting of gates and to occasional spills.

Change Pouring Practice

Large down-gates, necessitated by pressure of steel from the bottom tap ladle, have been eliminated, thus making it possible to pour the molds with less steel. A roller bearing truck on an industrial track extending from the main bay into the west bay brings the hot metal into the west bay in a teapot type ladle with capacity of 4000 pounds. This ladle is filled at the electric furnace and carried to the truck on which it is pushed into the west bay. In addition to the savings mentioned, the present method of pouring in the small castings department takes much less crane time than under the old bottom pour method.

From the molding department, the small castings proceed down the west bay through various stages until they come to the shipping department at the end of the bay. After they are shaken out the castings are placed in small steel boxes which rest on skids. These boxes are picked up by an electric lift-truck and taken to a roughing tumbler. This tumbler formerly was in the main bay, but has been moved into the west bay to save travel of the castings to it. After rumbling for a period of about one hour, the castings are removed and placed in a space across from the rumbler where the heads and gates are removed by an oxy-acetylene torch. They then are reloaded into the boxes and conveyed by the electric lift trucks to the next station, where the grinders are located and are ground.

Special attention was given to grinding the small castings and savings in several directions were effected. One of the two grinding units is a high-speed double-end grinding stand of a new type. The other is an 18-inch swing grinder; used particularly on the castings too heavy to be handled conveniently at the double-end stand. The new double-end stand is provided with elastic bonded wheels operated with safety at 9000 to 10,000 surface feet per minute, compared with 5000 for the old double-end grinding stands. The new high-speed stand has supplanted four of the old double-end stands. The grinding department, it is stated, now does more work, with less equipment and less labor, and with a great saving in the amount of floor space required.

After the grinders come the air chippers. A welding booth is located in the main bay with an extension into the west bay. The welding booth occupies the space in the main bay formerly occupied by the rumbler which was moved into the west bay. The welding booth is commanded by the cranes so that heavy castings produced in the main bay can be taken

to it conveniently. The extension into the west bay makes it also readily accessible to the small castings. Next, in the west bay, is a small department for dressing welds and for final chipping. When the castings have been cleaned, they are given a heat treatment after which they are placed in the finishing rumbler, a new piece of equipment of standard type. Then they are taken to the inspectors' table where they are checked for dimensions, shrinkage, etc. They finally are delivered, at the north end of the west bay, to the scales, for shipment to one or another of the company's machining departments.

Facing sand is prepared in the east bay. Under the new layout the problem arose of efficiently transporting sand from the mixers to the molders in the west bay, and getting the excess heap sand back to the mixers. A concrete runway was extended from the main bay terminal of the hot metal track to the concrete floor in the east bay on which the sand mixing apparatus and the core departments are located. For transporting sand, steel boxes with long legs were built by the company. The electric trucks can get under and lift them, and they are high enough so that the molders can get at the sand with minimum effort. A full box with a capacity of 18 cubic feet always is on hand at each molding bench.

In somewhat the same manner the problem of getting the excess burned sand back to the mixer was solved. Gravity dump buckets with capacity for one-half cubic yard each, are placed on skids in the west bay, and loaded with the excess sand. These buckets are transferred by the electric truck into a position on the concrete runway where the traveling cranes can pick them up. The crane dumps the contents of the buckets into the hopper of the sand-reclaiming machine in the east bay.

From the hopper, the sand is fed through a set of crushing rolls which breaks up the lumps. Then the sand drops on a belt which carries it over a magnetic separator to remove nails, wire, shot, etc. The sand then falls into an elevator boot and is carried to a vibratory screen provided with a dust collector. The fines separated from the sand are not wasted but are used in the core mixtures. The resulting molding sand, minus the fines and the dust, goes back into the facing. Much of the sand-reclaiming apparatus was designed and built by the company.

Describes Floor Molding

Floor molding of large castings in the main bay is done substantially the same as before. Savings in space have made it possible to add five more molders to the crew in the main bay. Shifting the flask storage from the center portion of the main bay, to the space where the machine and bench molders formerly did their pouring, has made space for a shakeout floor for the large castings. This shakeout floor is adjacent to the sandblast chamber. The chippers, instead of being strewn over the entire north end of the main bay, have been moved over to the east side of the main bay, with a straight, orderly line of benches and air connections.

In addition to getting out a greater volume of production from the same space, with a resulting lower cost per pound, the company finds that the changes effected make it possible to operate the steel foundry with less supervision. With all details of the foundry operations clearly understood, and all moves in accordance with a set schedule, there is less opportunity among the employes for making mistakes.

An interesting feature of the Treadwell Engineering Co.'s steel foundry is the 3-ton, electric furnace of the heroult type. It is of the original rectangular shape and is said to be the first electric furnace installed in the United States for the commercial production of steel castings. The first heat was melted in this furnace September, 1911, and the furnace ever since has been in steady operation.

W. R. Forrester, superintendent of the Treadwell Engineering Co. steel foundry worked out the application of straight-line production methods described in this article.

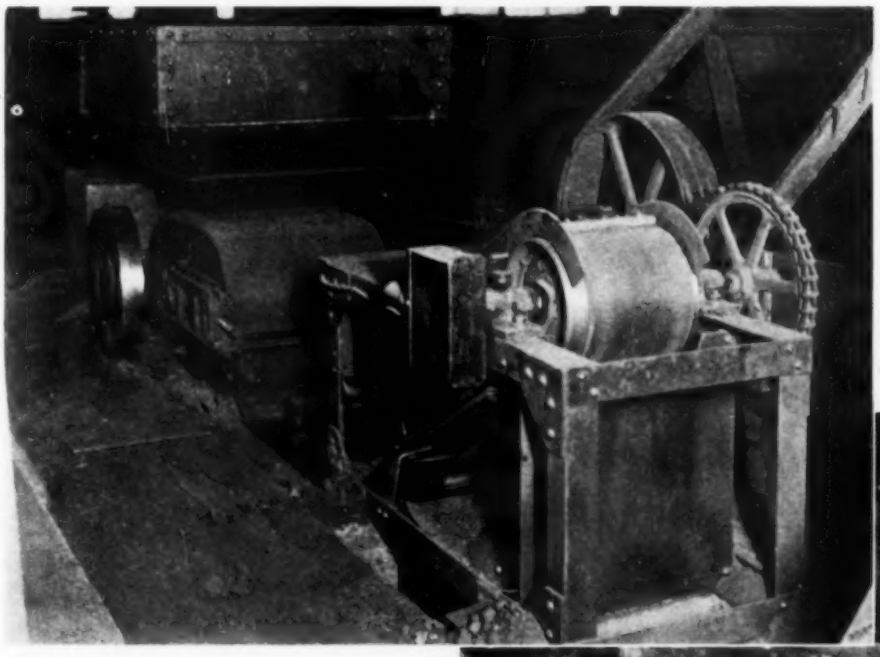


Fig. 6 (Right)—A Crusher and Magnetic Separator Are Used in the Sand Reclaiming Unit. Fig. 7 (Below)—Concrete Bins Have Been Built in the Storage Department

European Practice Viewed by American Foundrymen

Difference in Men, Methods and Machinery Noted in Brief Digest of Opinions of Visitors to London Congress

IMMEDIATELY after the return of the American party which attended the Third International Foundrymen's congress in London this summer, THE FOUNDRY requested an expression of opinion and a review of the facts gleaned by members of this party. It will be recalled that many of the party spent several weeks before the London meeting touring England and Scotland where they were received with the greatest hospitality and given full opportunity to visit and inspect typical and outstanding shops of the cities visited. Some of the party returned to America immediately after the convention was ended. Others hastened to the continent and were courteously received in many foundries of France, Germany, Holland and Belgium. A few remained in Europe until late summer and accordingly the assembling of this cross section of opinion has been delayed slightly, but "now it can be told."

The views here given are presented without the names of the persons contributing them. They may be said to represent the opinions which might be expressed by practically any observant American foundryman, technical man or executive, who might have a similar brief opportunity to study overseas practice. Some commented reluctantly, realizing the exceedingly limited time and the necessarily superficial judgment which must result from such a fleeting view. As one foundry manager said,

"I rather hesitate to comply with your request, because I always have had a good deal of antipathy for those people who jump across the water, spend a week in this country and then start writing articles and lecturing on what is the matter with America. I saw only four foundries making our class of work. I wasn't in any of those plants more than two hours. To attempt to arrive at any conclusions or draw any deductions under such a condition is to make statements of opinion with a very flimsy basis of facts behind them."

THE FOUNDRY accepts this honest statement, but nevertheless believes that and expression of opinion, cross sectioned from many competent men has a definite value to its readers. Furthermore, frankness, which is an elementary and admirable trait of the British, probably will be graciously accepted, particularly when predicated upon a friendly interest, enhanced by appreciation of the exceptional hospitality extended to all the American visitors by their British hosts.

Practically all were impressed by the attention to quality, the insistance upon careful finish and perfect surface condition of castings in the various foundries visited. An eastern foundryman says:

"I have the highest respect for the English foundrymen. One of the things I noticed particularly was the care that they exercised in finishing molds; although an excellent foundry

Well Equipped Foundries in Practically Every Case Were Provided with Glass Roofs Which Give Ample Daylight Illumination on the Floors

practice, it seems to me that a great deal of it is unnecessary, as the essential quality of a casting is soundness in machining, and if a casting appears a little rough, this does not affect the quality or value of it after machining."

One factor which attracted universal attention was the manner in which ample and plentiful risers were supplied for castings. An American maker of high quality automotive and general jobbing castings says:

"Unusual thought is given to the proper gating and venting of each individual job. While this gating practice follows general lines, it was individually worked out for each different type of casting. In comparison with the American practice, I would say that the British foundries are more generous with the use of risers and in fact, seem to be quite willing to use a large riser on a comparatively small casting."

Use Large Risers

The same point was emphasized by an eastern maker of general machine castings who cited a specific job at a British plant making marine engineering castings. He says:

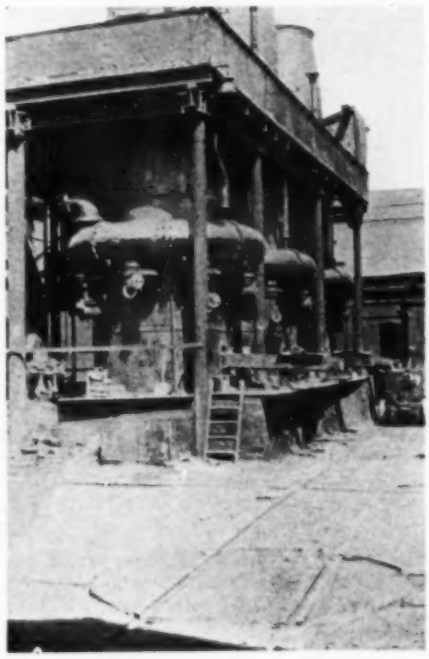
"In the first place, what impressed me most was the thoroughness of our European friends to secure a sound and uniform casting. For example, at one works, I noticed packing blanks and bushings with risers equalling one-third the weight of the casting. As an illustration, they had a bushing 30 inches in diameter and approximately 60 inches long. Twelve inches of this was used as a riser and was cut off in the machine shop and returned to the foundry for full credit, thereby guaranteeing a sound and homogeneous casting. This goes to show how willing the machine shops are to cooperate with the foundry to secure a uniform casting."

Apparently European foundrymen and more particularly those in the British Isles, have not felt the need for close and detailed attention to sand, although some of the larger works at present are conducting control and research tests. It is universally observed that rebonding with fire clay, bentonite and other materials which is practiced rather generally in this country is almost unknown on the other side. One American jobbing foundryman making high grade light gray iron castings comments as follows:

"From the standpoint of sand investigation, they seem to be now about where our American Foundrymen's association sand committee started some years ago. We noticed their reluctance to adopt American sand testing methods although a laboratory man in one of the plants told me that our American testing equipment was far superior to anything that has been developed in England. They have since been developing their own equipment and consequently will have to pay for the development period in the loss of time. Only the largest shops are doing anything on sand research, the small shops really do not know what it's all about."

Dry sand molding is generally practiced abroad, particularly in the marine engineering shops and many of the jobbing foundries also dry the majority of their molds. In Germany it was observed that more than 70 per cent of the work in foundries visited was made in dry sand. The quality of workmanship in finishing these molds is noteworthy. Each mold is the work of a master craftsman and excellently finished.

The control of every step of manufacture seems to be closer maintained in European foundries than in American. Technical men direct the selection of material, designate mixtures and follow closely by analysis and inspection every step in the production. This point in general attracted favorable comment although a few felt that this was carried to extremes. One foundryman remarked:



England's Mild Climate Permits Many Shops to Set the Cupolas Out of Doors

"Laboratory control is, undoubtedly, a necessity and probably here to stay. My contact with people who are in control of such laboratories has led me to believe that they do not have sufficient regard for the practical knowledge of the foundry superintendent and his workers."

Of course, this represents a foundryman's viewpoint, but even those identified with the metallurgical branch of foundry management felt that perhaps too great stress was laid upon this feature. One says:

"The close technical control also impressed me. They would have for a daily melt of 40 to 50 tons, a total force in the chemical, physical and micrographical laboratories of ten men. This seemed to be practically standard practice. For a daily melt of 200 to 250 tons I know a large plant on this side that has a total force of only seven men."

In many cases on the continent, the same as in England, this point was clearly evident as is shown by the comment following:

"On the continent especially, technical research and control of product occupied a most important position in the operation of the plant. Foundries melting only 50 to 75 tons per day had extensive research and control laboratories. The microscope in the study of iron played a tremendously important part and I am afraid would put some to shame who have felt that the microscope was limited in its application to cast iron.

There was much evidence of research in regard to something more than quality of test bars in that evidence was at every hand, which indicated a study of the characteristics of the casting itself.

Metallurgically speaking, I am not so sure that they are actually further advanced in knowledge than we are in this country, although I am of the impression that the knowledge that they have is possibly applied more generally to the metallurgical betterment of the product."

Special Irons Studied

The evidence of this attention to the technical side as an aid to advancement is supported by some of the comment on special types of cast iron observed. One foundryman who made a close study of this matter says:

"A patented process for the production of pearlitic cast iron is quite generally used for marine engine work. When one considers the practice of dry molding, loam molding, and other exceedingly intricate methods of producing quality castings, you will see that this process is just one step farther, in that it is necessary to first make a careful mold, paint the surfaces, and secure the sharp edges and pockets and finally place the mold in an oven for drying. The temperature is then raised as quickly as possible to about 950 degrees Fahr. After this, the oven is held at this temperature for eight hours at which time the molds are poured while still hot. The first question that naturally comes to one's mind, is how do they keep from burning up the cores and edges of the mold with a temperature of 950 degrees Fahr? The answer is simple; each mold is closed an sealed by closing all risers, and pouring gates, so that the heat must penetrate from the outside towards the center. Were these riser openings left open, a circulation would be created inside the mold and this would, of course, soon dry out the cores, and all of the corners and pockets in the mold, resulting in failure upon the application of the hot metal."

This comment referred more particularly to British practice. An observer who was in Germany says:

"The character of metal used on the Continent is high. They run small cupolas and nearly every foundry we

Left—John Shaw Expounds Gray Iron. Right—E. Player, Coventry, Is Host to M. J. Evans, Chicago and Robert Crawford, Detroit

Below—Tom Makemson, General Secretary of the I. B. F. Center — H. G. Sommerfield, Honorary Secretary of the London Congress. Right — H. Winterton, Glasgow, President of the Equipment Association

Lower left—Fred Erb, Detroit, President of the A. F. A., R. W. Stubbs, Manchester and Wesley Lambert, President of the I. B. F. Below—Frank Russell, Sheffield and W. Jolley, Manchester, Enjoy a Smile Together

visited employed a patented process for making iron castings. Several foundry engineers stated they did not use the patent but made their own type of pearlitic iron. Some foundries refine their cupola iron for special castings in electric or oil fired furnaces. They often use the same flare riser on diesel liners, etc., we saw in England. In one or two foundries the risers were so heavy they were cut off in the cleaning room with saws. The sand used must be of good quality as we saw but few buckles or scabs in the seventeen foundries visited. Their equipment was good. Everywhere we saw American molding machines, jarring machines, mixers, sand slingers, moving tables for molds, moving racks to core ovens, and in one place an automatic molding machine. The workmanship was excellent, every effort being made to maintain a high quality. In one foundry we came across several diesel pistons with small defects. These were marked as scrapped. I asked, why the defects could not be plugged and was informed that the company—"does not allow the patchings of castings." A low carbon remelted, or refined pig was in common use for special works in England, although in Germany the trend was more toward using higher percentages of steel in the mixture. This refined pig is made by melting in the cupola 50 per cent steel and 50 per cent pig iron and pouring into shape suitable for cupola use. This is sometimes done to obtain a low carbon in the cupola charge. The pig iron in both countries is lower in carbon than we are able to obtain here."

Use Special Processes

The use of special mixtures or special process in preparing molds or treating iron castings seems to be confined to shops making heavy work. A foundryman from this side who makes light gray iron castings says:

"I noticed that those foundries who are making castings for turbines and large pumps and diesel engines are pretty well posted on the metallurgy of cast iron for that purpose, but certainly in the production of automotive castings and small hardware parts, they seem to be far behind American research and engineering on the metallurgical end, this is probably due to the small amount of production they have in this line. I also notice that their metallurgical problems are quite a bit different from those of us who are operating foundries in the North because of the types of pig iron that are available to them in comparison to ours."

Except for a few outstanding instances among which was a large steel foundry, a gray iron foundry making railway specialties and an aluminum foundry, all of which equal if they do not excel the average American practice, the European foundries were appraised as being handicapped by lack of modern equipment. A keen observer of equipment trends noted:

"When I have been asked how European foundry practice compared with ours and what we saw of interest, my reply has generally been something to the effect that where European foundries have gone in for modern equipment and methods, they have done a job that would compare favorably with the modernization of foundries for a similar type of work in this country.

My next comment generally is that the percentage of modern or semi-modern foundries in England is probably smaller than here. It is quite natural that this should be so, as a great many of our foundries were built since the introduction of molding machines and other equipment for improving and increasing production.

With these comments I usually add that in the foundries where they do not have modern equipment, they do produce excellent castings, which emphasizes the fact that their molders recognize what is essential in the preparation of a mold and the pouring of metal to produce good castings regardless of equipment at hand and conditions surrounding them, whereas in this country it is generally felt that the management must provide every device and introduce measures and practices that will give the greatest assurance of good castings regardless of the skill and intelligence of the molder."

J. W. Gibney, Buffalo, C. E. Hoyt, Chicago, H. B. Hanley, Rochester and Frank Dodge, Detroit, Were Appreciative Guests of the I. B. F.

A steel foundryman mentioned one detail and perhaps a reason for some of the reluctance to install advanced equipment. He says:

"In many of the shops there was a notable absence of air-rammers in the foundry, and a more noticeable absence of air-driven chipping tools in the cleaning room. Some of the managers spoke of the fact that compressed air is an expensive form of power, which is undoubtedly true, but I suspect that another reason is the argument that I have heard advanced in this country, that it was useless to put in labor-saving devices, because the men would not allow the production to be increased, and that with the aid of rammers or chipping hammers the firm would not get sufficient increase in production to pay the interest on the investment."

The attitude towards molding equipment as expressed by some of the men is hard to appreciate unless one is familiar with the industrial background of some of the European countries. One foundryman says:

"I found considerable more molding machinery installed in their plants than I had expected to see, but of course, not nearly as much as you would find in American foundries of the same type. I think that the English foundryman has a *complex* against molding machine equipment which is unsound. I saw many applications of molding machine equipment where the foundryman stated that they did not find it practical to use machines on that type of work. Of course, we appreciate their employment problem and the social aspect that it might present from a business viewpoint, considerable more machinery could be used than they are now using.

A large amount of the equipment that they now have in their plant is not utilized to the fullest extent, probably due in part to the resistance on the part of the men, but I think also to lack of diligence on the part of the supervision. They can do a considerable amount of hand work on all of their molds and the resulting castings are much smoother and probably cleaner than castings produced under similar circumstances in American foundries. It is the old, old story, however, that in America the castings are good enough even if they don't look quite so nice and to make them look as nice as theirs, would add more to the cost than American casting buyers would pay. In Holland and Germany the workmen work harder but not like Americans. They use more mechanical equipment and better pattern equipment than in England.

Holland is especially receptive to not only American, but all foreign ideas."

Plants Are Overmanned

An equipment manufacturer with the American party cited an instance of what he believed to be a general condition where more men were employed than was necessary to perform the work at hand. He says:

"The most striking instance was in a certain foundry where two men were working a power squeezer making small castings in a cast-iron flask, or box, that could not have been over 10 to 12 inches square, when one man in America with the same power squeezer would have had a snap flask large enough to make four or six in the flask. There was too much sand used for the size of the casting and of course the molding machine was not working to capacity and the job was overmanned. Several of the shops were equal to ours, especially one malleable, one steel and one gray iron. Given a little time to recuperate from the war and to accumulate some funds, I am certain there will be a big change in English foundry practice."

Undoubtedly production per man or per unit of floor area is not as great in general on the European side as

it is in America. A steel foundryman commenting on jobbing foundries compared one large British steel foundry which was excellently equipped with a similar foundry in America stating that the ratio of British to American production was about 10 to 18.

The same point was apparent to a malleable foundryman who says:

"We visited one large malleable plant where the management were alert, aggressive, and keeping in contact with progress in other countries, and it seemed to me that their practice, in general, compared favorably with the usual American malleable foundry, and that they are destined to more than keep pace with the average development along these lines in our own country.

We also visited another foundry making gray iron, steel and malleable iron castings, in which the melting was done in electric furnaces from power generated in their own steam plant. Their production of malleables was small compared with the majority of our plants but here again the management seemed to be alert and aggressive and fully capable of maintaining their relative standing with the development of the art."

Well Trained Men

All of the party were impressed by the evident skill and sound craftsmanship of the European workmen. A jobbing foundryman was impressed by the difference in effort expended in accomplishing the day's work. He says:

"My impression of the British workman is, that he does not work nearly as hard as American workmen and of course you know that he does not earn nearly as much money, from an American viewpoint it would seem, more work and more pay would improve at least the domestic situation. They don't have any of the problems that we have with labor, namely that of getting enough of the right kind. They have an available supply of every type of skilled help and worker and therefore the replacement of such men is not so large an object there as it is here, where the men earn twice as much."

The apparent admiration of Americans for the skill of workmen is evidenced in the following:

"I was impressed with the fact that the men in their shops and the executives in charge knew fully as well as our people do the materials they were working with and what it was they were attempting to do. In fact I think it quite possible that a cross section of the workmen and men in charge have a better understanding of the fundamentals of the industry than would be found in a similar cross section of the industry in this country."

Another says:

"I have the feeling that on the whole, the foundry managers, foremen, and I suspect workmen, although naturally I didn't have a chance to investigate this, much, understand their particular jobs better than the corresponding men on this side. It seemed to me that the foundries were run more by engineers or technically trained metallurgists and less by exmolders than is the case with us. In saying this, I am speaking more of the jobbing industry with us rather than production foundries.

The big advantage I see in our foundries is social and not technical, namely, the fact that there is a road from the bottom to the top for anyone who shows the ability to fill the position, while over there it is exceedingly difficult for a man to rise very high unless he has been born to the job. This probably results in producing men better qualified for the intermediate positions, because they stay in one place and learn all there is to be known about that job, but it chills their initiative and incentive to improve or perhaps I had better say, to invent new ways of doing things, because the reward in the way of advancement is so much less sure than here."

One foundryman of the party who had worked in England many years ago commented on the fact that in a shop where he formerly was employed men still worked kneeling in the sand, a practice which was discarded in this gentleman's own foundry in America many years ago.

In making a summary of this cross section of opinion one fact was apparent in all of the communications. Those who made the trip brought back many points which they had learned from overseas foundrymen. The very difference in products offered incentive to possible extension of castings uses. A keen gray iron foundryman remarks that soil pipe foundries on the other side were making gutters and downspouts for residences all of cast iron. He commented on a standard production gray iron casting known as a railway chair, a product which has been described in THE FOUNDRY. It consists of a blocky iron casting weighing 50 pounds each and one is placed on each end of the cross tie carrying the rails. The rails are double headed and are fastened to these cast iron chairs. Tunnel segments for subway construction also were noted as being worthy of emulation on this side of the water.

Aluminum Foundry Practice Exhibited Fine Accomplishment Particularly in the Production of Large and Intricate Castings

Grinding Wheel Makers Report Progress

The Grinding Wheel Manufacturers Association of the United States and Canada held its annual meeting at Skytop Lodge, Cresco, Pa., Sept. 19-20. George Chormann, Carborundum Co., Niagara Falls, N. Y., chairman of the standardization committee, reported that further progress had been made during the year in simplifying the sizes and shapes of grinding wheels. The safety committee, A. Rousseau, Norton Co., chairman, reported progress on the exhaustive investigation of taper collars for high-speed wheels. A draft of the revisions of the general safety code for grinding wheels was presented and discussed briefly. Comments on the proposed changes in the code will be submitted to the safety committee in writing. The principal changes have to do with bringing the code up to date with respect to high-speed wheels. A draft of a proposed code of ethics was presented to the association.

Alloy Additions *Affect* Corrosion of Cast Iron

By Paul Koetzschke

DISINTEGRATING reaction of gray cast iron in acids is electrochemical in character. The local couples occurring in the structure as well as alloys introducing changes in potential are the principal determining factors in the rapidity of disintegration. While the graphite in gray cast iron is the cathode at which hydrogen is released, the remaining components of the structure form the anodes of the local couples. In the latter silicon also must be considered, which with ferrite appears as a solid solution in the matrix. Its influence on corrosion in acids can be seen in Fig. 12. Through the foregoing investigations it already has been shown that size and number of the graphite flakes present in equal graphite volumes have no real influence on the speed of disintegration.

However, to determine the action of the silicon satisfactorily, the influence of the remaining graphite volumes in cast iron had to be determined. In the melts 2a and 3a in which the graphite content was increased considerably for this purpose, through a short period of annealing, no increase in the attacking action could be observed as shown in Figs. 15 and 16. Rather, a decrease in the corrosion occurred which probably is to be traced back to the concentration equilibrium in the mixed crystals. The decrease of the corrosion curve in hydrochloric acid and acetic acid, therefore, must be attributed mainly to the influence of the silicon.

In this connection it should be noted that Casts 4 and 5, differing from Casts 1 to 3, exhibit a graphite structure of a temper carbon nature, brought about through a longer annealing treatment, and have a solid pearlitic, homogeneous matrix, which due to its greater density might offer a higher resistance than the higher silicon Casts 1 to 3. However, it must be assumed that these circumstances do not influence the corrosion behavior phenomena decisively and at most imply a flatter curve. A further drop-

Studies Alloy Effects

ACCORDING to the results of the investigation, silicon plays an important part in rust and corrosion resistance of cast iron. Nickel additions have a favorable effect in some instances and unfavorable in others. Chromium has a beneficial effect but increases machining difficulties. Reasons for these conclusions and other important data on corrosion and rusting of cast iron are included in this article which is the second of two on the subject.

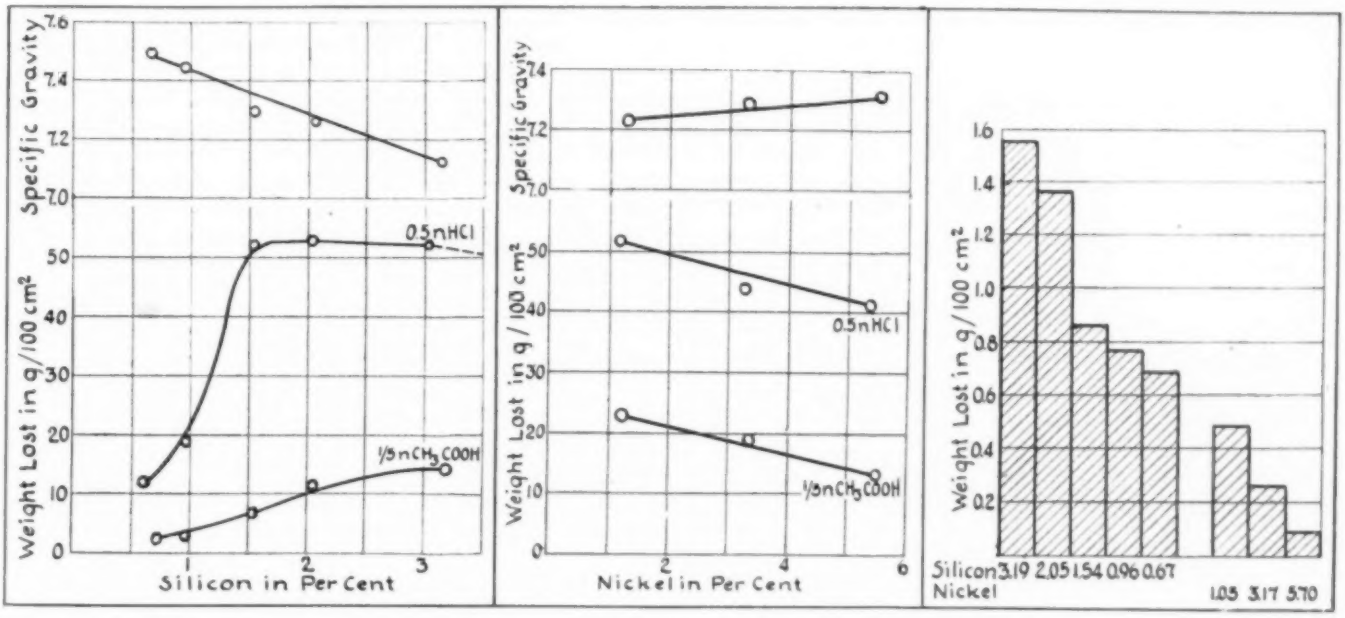


FIG. 12—CORROSION OF CAST IRON IN HYDROCHLORIC AND ACETIC ACIDS IN RELATION TO SILICON CONTENT, AND RELATION OF SPECIFIC WEIGHT AND CORROSION COMPILED FROM MELTS 1 TO 5. FIG. 13—CORROSION IN HYDROCHLORIC AND ACETIC ACIDS IN RELATION TO NICKEL CONTENT. FIG. 14—CORROSION IN 25 PER CENT CAUSTIC POTASH AT MAXIMUM TEMPERATURE 230 DEGREES CENT. FOR 15½ HOURS

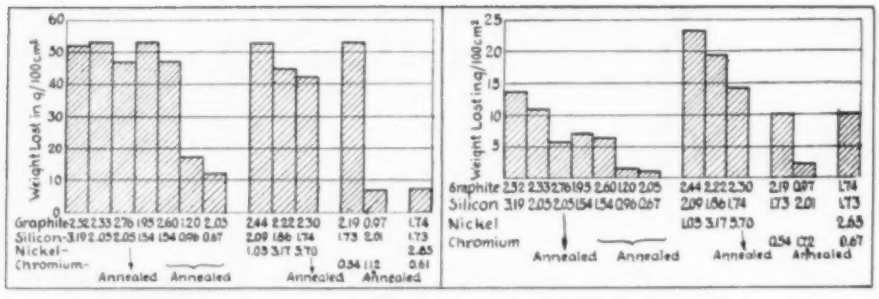


FIG. 15—THREE-DAY TEST OF CAST IRON WITH VARYING GRAPHITE CONTENT IN HYDROCHLORIC ACID. FIG. 16—CORROSION OF CAST IRON WITH DIFFERENT GRAPHITE CONTENT IN ACETIC ACID FOR 6 DAYS

ping of the corrosion curve should be noted, particularly between Casts 4 and 5, although both display entirely like structures and the latter also contains a considerably higher amount of graphite.

As the behavior of silicon in usual commercial iron cannot be explained by the protective action of a silicic acid coating or a possible stable acid silicide, as is assumed in the case of high silicon admixtures, our results justify the assumption that the silicon in cast iron forms mixed crystals with varying degrees of concentration of the alloy components. In these the predominating or prevailing mixed crystal occurring with lower contents is unstable as compared to acids and increases the corrosion, whereas the mixed crystal occurring with higher percentages is stable and is capable of reducing the corrosion.

Silicon contents between 1.5 and 3 per cent are incapable of exerting any influence in hydrochloric acid and thereby the earlier investigations of Friend and Marshall as well as Schenck are confirmed. Haase, on the other hand, recently found a continual drop of the corrosion curve in hydrochloric acid with a decreasing content of from 3 to 6 per cent and also set 1.3 per cent silicon as the point of inflection in the curve, for which, however, he does not offer any explanation.

Improvement or potential change of the metallic matrix through the additions up to 6 per cent nickel does not correspond to expectations. As is evident from Fig. 15, the hydrochloric acid corrosion is reduced about 20 to 25 per cent. In acetic acid, on the other hand, even slight nickel contents at first increase the intensity of the attack as shown in Fig. 16, and not until greater additions are made does a decrease in corrosion again occur. This fact is worth noting, as with an increasing nickel content the formation of a hardened structure is favored, so that with 5.7 per cent nickel a pure martensite structure exists. While at the same time the fracture showed a most extensive grain refinement, the refinement in the graphite structure with an increasing nickel addition as stated by various investigators could not be observed closely enough to make it conclusive.

Reference should be made to the results secured by Haase, who established a decrease in corrosion of over 50 per cent with an increase in nickel content up to 0.8 per cent in 1 per cent and 10 per cent hydrochloric acid and ascribes this favorable influence less to the chemical behavior of the nickel than to its physical properties, as it favors the production of a fine grained and dense structure. In view of the fact that a favorable influence of the nickel on the density of the metal also could be noted in the foregoing investigations (Fig. 13), there is hardly any doubt, but that this assumption is correct. However, according to our investigations, the strong protective action of a nickel content of only 0.8 per cent must be somewhat questionable. Especially as Haase also has determined a reduction

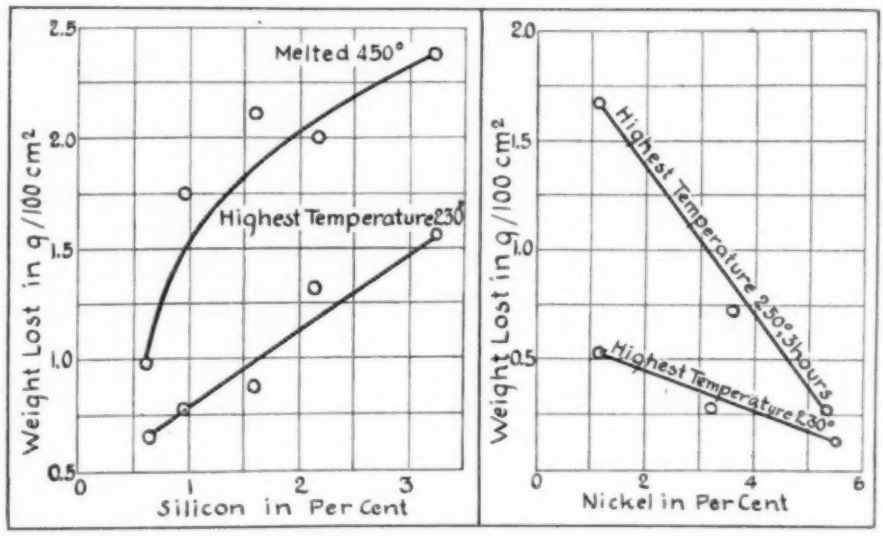


FIG. 20—RELATION OF CORROSION AND SILICON CONTENT IN CAUSTIC POTASH AT DIFFERENT TEMPERATURES. FIG. 21—CORROSION OF CAST IRON IN CAUSTIC POTASH AT DIFFERENT TEMPERATURES IN RELATION TO NICKEL CONTENT

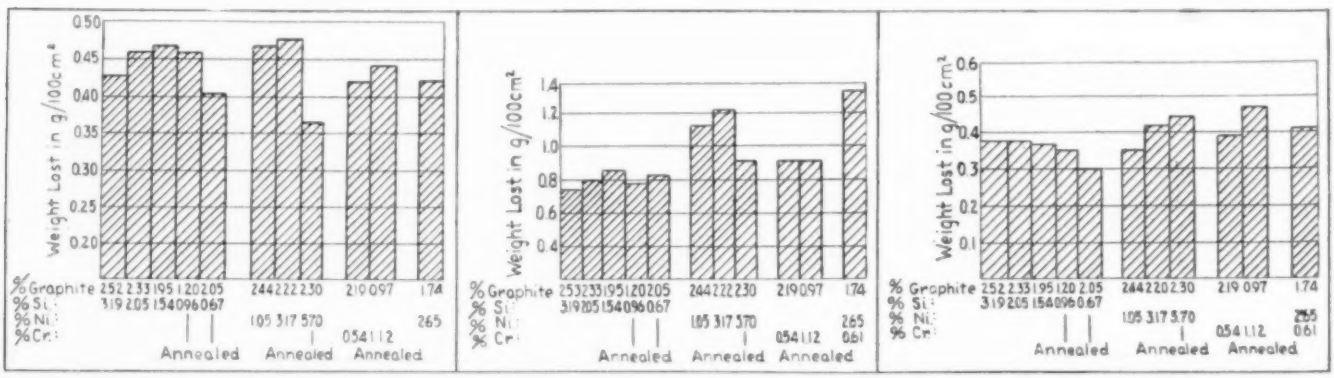


FIG. 17—RUST TEST IN COMMON SALT SOLUTION FOR 22 DAYS. FIG. 18—FOURTEEN-DAY TEST IN AMMONIUM SULPHATE SOLUTION. FIG. 19—RUSTING TEST IN 20 PER CENT CALCIUM BICARBONATE SOLUTION FOR 21 DAYS

in corrosion of 25 to 40 per cent with 0.8 per cent nickel, while Bauer and Piwowarsky could detect only a maximum of 20 per cent, and Everest and collaborators even observed an unfavorable influence in sulphuric acid corrosion.

A refining influence of chromium alone, first is observed, as shown in Figs. 15 and 16 after an addition of at least 1 per cent. Then the corrosion drops off considerably in hydrochloric and acetic acids in consequence of the accumulation of the acid stable chome-iron-carbide in the basic structure. However, this advantage is offset considerably due to the difficult machinability of the metal and the need of a longer annealing period of the mottled solidified casting. On the other hand, the metal alloyed with chrome and nickel shows along with good machinability also a good behavior in hydrochloric acid as shown in Fig. 15. In acetic acid it does not produce any worthwhile improvement, due to the unfavorable influence of the nickel. Reasons for this still require further investigations. The results are given in Fig. 16.

Use Strong Alkalies

As great attention has been paid to corrosion resisting cast iron in the alkali manufacturing industry owing to the large use of equipment, and previously only investigations conducted mainly with reference to the behavior of cast iron in alkalis of slight concentration, investigations whose results are shown in Figs. 14, 20 and 21 were carried out. The influence of the alloying elements will be understood, when the behavior of the pure metal with respect to strong alaki is known. Silicon is attacked strongly in strong alkalis. Therefore, the potential of cast iron experiences a shifting to the less noble or baser side, with an increase in silicon content. The dissolved or released silicon in the metallic matrix containing mixed crystals is attacked by the caustic potash and taken up by the melt under silicate formation. The remaining exposed structural constituents with the exception of the graphite which remains on the test piece as an insoluble component, are exposed defenselessly to the further attack of the caustic potash.

By the addition of nickel to gray cast iron on the other hand, the attack is diminished substantially as nickel is one of the metals which next to silver, are attacked least by alkalies. The potential of the cast iron experiences a strong increase through the nickel with which the iron forms an unbroken series of mixed crystals, whereby increased protective action is

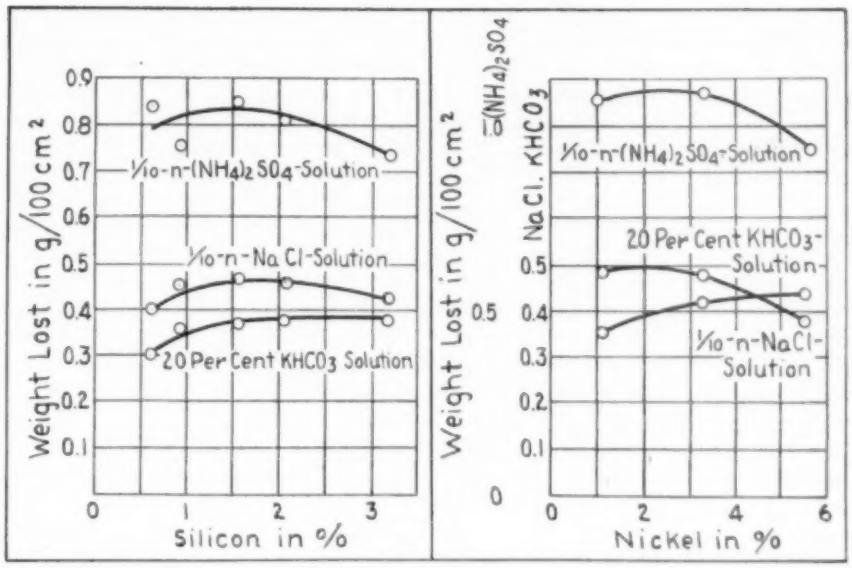


FIG. 22—RELATION OF RUSTING AND SILICON CONTENT IN SALT SOLUTIONS. FIG. 23—RUSTING TESTS IN SALT SOLUTIONS IN RELATION TO NICKEL CONTENT

produced by an increase in nickel content. This favorable influence is shown clearly in Fig. 14. The attack on the cast iron alloyed with 5.7 per cent nickel amounts to only 1/16 of the attack on usual iron with 3 per cent silicon. On these test pieces one could not determine externally any corrosive action at all as they retained their original bright polished surfaces.

While in the corrosion of cast iron the potential differences occurring between the individual structural constituents which are considerably influenced by the addition of the alloying elements play the leading role, these influences decrease during the rusting process in salt water solutions (Figs. 17, 18, 19, 22 and 23). Here the electrochemical currents more often govern due to differences in the concentration of the fluids, particularly due to differences in the concentration of the oxygen. Oxygen diffusing from the fluid's surface into the neutral or acid solution oxidizes the resulting ferrous hydroxide to ferric hydroxide on the contact surfaces of the anodes and cathodes.

This ferric hydroxide forms a brown, flaky and not strongly adherent precipitate in common salt and ammonium sulphate solutions, which only superficially covers the test piece and in the main sinks to the bottom. A protective action hardly can be exerted. On the contrary, its presence is rather corrosion producing, as it in turn tends to produce potential differences on the surface of the test pieces. Thus, after removing the rust from the test pieces corroded in the common salt solution, a distinct zone formation could be noted. Surfaces which were covered thoroughly with the brown, flaky rust experienced the strongest attack while the remaining surfaces on which only a small amount of hydroxide had been precipitated, actually bore a steel blue oxide coating on the surface, which protected it

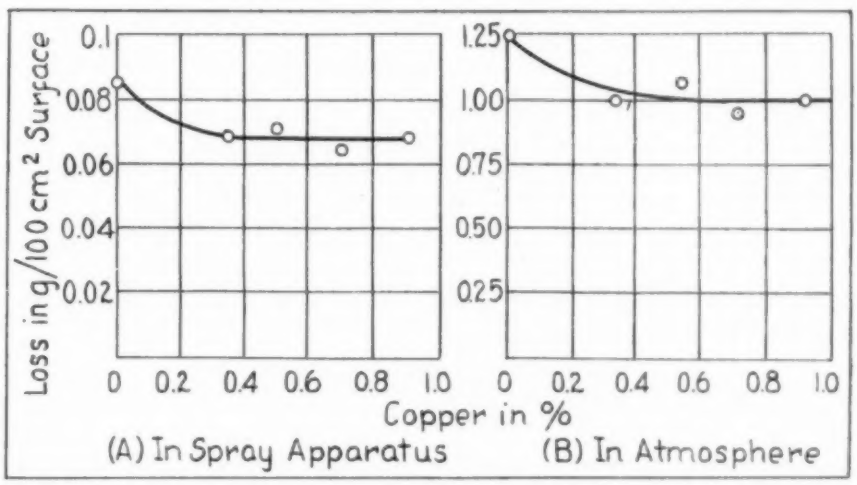


FIG. 24—RESULTS OF WEATHERING TESTS ON COPPER BEARING CAST IRON IN THE SPRAY APPARATUS AND IN THE OPEN AIR

from further attack. On the other hand, in the calcium bicarbonate solution the iron by liberation of hydrogen recognizable by the detached bubbles adhering to the test piece, goes into solution according to the equation:

$$Fe + 2KHCO_3 + 2H_2O = Fe(HCO_3)_2 + 2KOH + H_2$$

as primary carbonate, and the oxygen assumes the role of a depolarizer, in that it removes the hydrogen.

Inasmuch as the structure of the gray cast iron does not exert any considerable influence on the rusting quality, as is already evident from the results of the investigations given previously, there was no extraordinary action to be expected from the varying physical forms of graphite or from the refining elements used, silicon, nickel and chrome, in the quantities employed in our investigations. Results of the preliminary and main investigations prove this assumption. Therefore, it is to be suspected, that only considerably larger quantities of metal additions as employed in steel are capable of more strongly diminishing or preventing rust attack of gray cast iron.

Through the weathering investigations it was to be determined, whether the success obtained with steel through the addition of copper also could be noted in gray cast iron. The melts designated in Table I, as *C*, *B*, *F* and *E* (Copper and slight chromium content in casts *C* and *F* have no bearing) served as the investigated media and the unalloyed Cast 2 (Table II) served for comparative purposes. The test pieces were placed in a closed test cabinet whose operation is evident from Fig. 25, and exposed to this moist atmosphere for a period of five days without coming in direct contact with the drops of water. As is evident from Fig. 24a, the observed losses in weight were so small as a result of the slight rust formation, that a repetition of the test appeared advisable. Nevertheless, to be able to employ this simple apparatus for short corrosion tests, it was deemed advisable to use water containing salt in the spray instead of tap water.

In a new series of tests the test pieces were exposed to the atmospheric corrosion for 28 days. The results (as shown in Fig. 24b) agree fully with those of the copper test. A copper addition of 0.3 to 0.4 per cent decreased the atmospheric corrosion of cast iron by about 25 per cent. Higher copper additions did not produce any further benefit. The action of the copper addition does not depend, as could be determined on removing the rust layer, on a particular or special action of the copper as an alloying element through ennoblement of the potential, but just as in steel it enables the surface of the cast iron to retain tenaciously the accumulating nonporous rust layer as a dense coating as it were, and to protect the underlying metal from further attack. Compared with acid corrosion, a copper addition up to 0.9 per cent (contrary to results obtained by Denecke) did not prove of any benefit.

With case iron the nature of graphite segregations, which can be accomplished through varying high melting superheats or changed cooling speeds, has no real influence either on the corrosion in acids or on the rusting in salt water solutions. The amount of graphite per surface unit also has no real influence on corrosion, as long as it remains within the customary limits of gray iron.

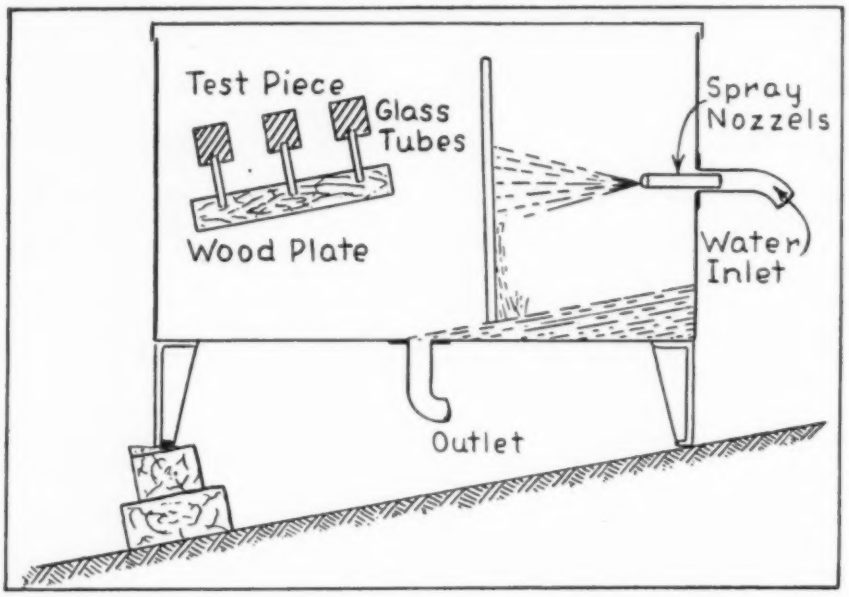


FIG. 25—CONSTRUCTION OF THE DEVICE USED IN THE SPRAY TESTS OF SPECIMENS

Silicon contents below 1.5 per cent decrease corrosion in hydrochloric acid, and silicon contents below 3 per cent will diminish corrosion in acetic acid. In strong alkalies and caustic potash on the other hand, corrosion increases rapidly up to 3 per cent silicon, while in salt water solutions silicon contents from 0.7 to 3 per cent have no effect on the rusting process. In all cases, where acid and alkali corrosion of ordinary cast iron is to be expected, it should be specified that the silicon content of the iron be kept as low as possible.

Nickel additions to gray cast iron up to 6 per cent do not favor corrosion resistance to any considerable extent in acids. However they do show worthwhile improvement in combination with moderate additions of chromium. In strong alkalies the attacking action is reduced perceptibly by nickel additions, so that these are of considerable benefit in apparatus used for preparing concentrated alkalies by evaporation. On corrosion in salt water solutions, nickel additions up to 6 per cent are without any noticeable effect.

Reduces Acid Attack

A chromium addition of 1 per cent to gray cast iron substantially diminishes acid corrosion, at the expense to be sure, of its machinability. On rusting in aqueous solutions it is however without effect.

A simultaneous addition of chromium and nickel (about 0.5 per cent Cr and 2.5 per cent Ni) substantially diminishes the attack of hydrochloric acid. With rusting in salt water solutions the simultaneous addition of nickel and chromium is rather a detriment.

An addition of copper up to 0.9 per cent did not show any effect on acid corrosion. On the other hand, in common salt the attack is perceptibly decreased with an increasing copper content. Resistance of gray cast iron against weathering action is increased 25 per cent by copper addition of 0.3 to 0.4 per cent. A higher copper addition does not bring about any further improvement.

Issues Safety Bulletin

National Safety council, 108 East Ohio street, Chicago, recently has issued its safe practices pamphlet No. 35 on conveyors. The pamphlet deals with the various types of conveyors and the safety precautions that should be used during their operation. The pamphlet is illustrated with halftone reproductions and drawings of safety appliances and different types of conveyors.

SMALL BRASS FOUNDRY Supplies Firm's Needs

Centrally Located Oil and Coke-fired Crucible Furnaces Melt Sufficient Metal for 6000 Pounds of Castings a Day

By Edwin Bremer

SPECIAL features of the gray iron foundries of the Chicago Hardware Foundry Co., North Chicago, Ill., were described previously in the August 15 issue of THE FOUNDRY. These included storage of materials, cupola charging, and methods of producing specific types of castings. Interesting methods also are followed in the core room, cleaning of castings and the nonferrous department of that foundry.

Core Department Is Separate

Cores for the castings produced in the four gray iron and nonferrous foundries are made in a separate building which is self-contained in that the core sand is stored, and that the cores are made, baked in the same building. The sand storage bin is along one side and end of the building, and is constructed of concrete. The floor of the bin is below that of the building floor proper, and the outside door through which sand is admitted to the bin is about 8 feet above the ground level. Sand is transported into the bin by a portable conveyor which bridges the gap between the railroad track in front of the building and the door of the bin. When the bin is full it has a capacity of 600 tons of core sand.

Sand for the cores is compounded in sand mixers manufactured by the Blystone Mfg. Co., Cambridge Springs, Pa. From the mixers the sand is carried in wheelbarrows to the core benches shown in Fig. 1 and to the core machines in a room adjoining. As may be observed from the illustration, the core room is well lighted. Natural illumination reaches the work benches through the numerous steel sash windows which almost fill the side wall. The core department is well ventilated by these same windows and the high roof. Cores are baked in four ovens which are separated from the rest of the building by brick walls, one of which may be seen at the left in Fig. 1. Two of the ovens are the drawer type for small cores, and the other two are the rack type as depicted in Fig. 2. The four ovens were supplied by the Foundry Equipment Co., Cleveland. Temperatures in the rack ovens are controlled automatically between 450 and 500 degrees Fahr., by recording temperature control apparatus supplied by the Foxboro Co., Foxboro, Mass., and by Schaefer & Budenberg Co., Brooklyn, N. Y.

As previously mentioned a large part of the 80 tons of castings produced by the Chicago Hardware Foundry Co. consists of window locks and handles, door pulls, and other types of builders' hardware. Since these castings are small, an extensive installation of grinding and cleaning equipment is required to provide facilities for handling large volume and to prevent these departments from becoming bottlenecks of the plant. Castings are ground on 75 stand type grinders. These are installed in a building adjoining one of the foundries.

Describes Equipment

Twenty tumbling mills arranged in 5 rows of 4 mills each are used to clean such castings upon which this method is desirable. The tumbling mills are located in a room adjoining and opening into the grinding department. The method of arranging the two departments permits short transportation of material from one to the other, but to a great extent shuts off the rattling and rumbling of the mills from the grinding department. While the mills are attached to an exhaust system to carry away the dust, it is difficult to remove it entirely from the room, particularly when the mills are being charged. Installation of the mills in a separate room confines this dust to one

FIG. 1—VIEW OF THE BENCHES IN THE CORE ROOM. THE WALL AT THE LEFT SEPARATES THE OVENS FROM THE REST OF THE DEPARTMENT. FIG. 2—AUTOMATICALLY CONTROLLED RACK TYPE OVENS IN CONJUNCTION WITH DRAWER TYPE OVENS BAKE THE CORES

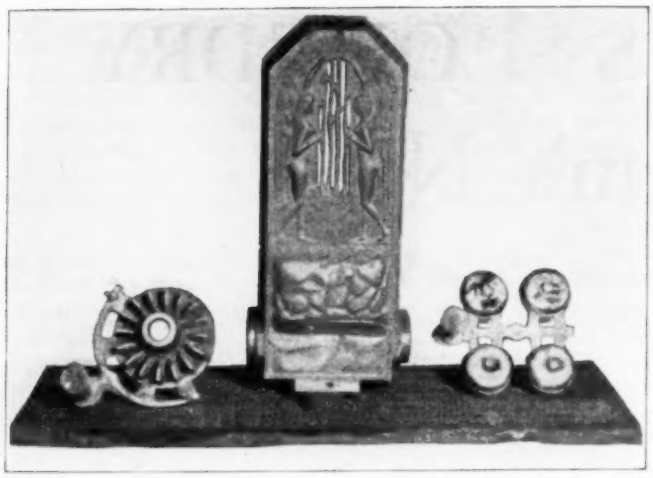


FIG. 3—THREE CASTINGS IN WHICH DIFFICULTY MAY BE ENCOUNTERED IN MOLDING

place and does not pass into the shop.

In some instances it is desireable to clean the castings by other methods than tumbling to obtain a surface finish. In these cases the castings are sandblasted either in a rotary table type or room type sand blast supplied by the Pangborn Corp., Hagerstown, Md., or in a sandblast mill built by the American Foundry Equipment Co., Mishawaka, Ind., or in two sandblast barrels supplied by the Mott Sand Blast Co., Chicago. Similar to the arrangement of the tumbling mill and grinding departments, the sandblast apparatus is installed in a separate room which adjoins these departments. Large castings such as the end for the laundry machine described in the previous article on the foundries of the Chicago Hardware Foundry Co. which appeared in the Aug. 15 issue of THE FOUNDRY, are ground and chipped with pneumatic tools supplied by the Independent Pneumatic Tool Co., Chicago.

While most of the castings produced by the firm are made of gray cast iron, a small quantity of nonferrous castings also are produced. The alloys used include red and yellow brass, bronze, aluminum, manganese bronze, nickel silver, and monel metal. The nonferrous foundry is constructed of brick and is approximately 30 x 75 feet. As is customary the molders' benches are arranged along the walls so that they receive all possible light, and the floors on which the finished molds are placed extend from the benches to the central gangway. Sand for the molds is screened by gyratory type riddles supplied by the Great Western Mfg. Co., Leavenworth, Kans., and by the Foundry Supply Co., Chicago. This is done several times each week to remove any scrap metal that may cause defective castings, and to keep the sand in good working condition. Metal is melted in 11 coke-fired furnaces, 3 oil-fired pit furnaces and 1 oil-fired, iron pot furnace for aluminum. The furnaces are placed approximately in the center of the foundry, and extend partially across the width of the building. This arrangement of the furnaces permits a short carry of molten metal from the furnaces to the molds, and allows more molding space than when the furnaces were placed in a row along one side of the building. The average production of castings in the nonferrous foundry is 3 tons daily.

While the methods employed in this foundry follow those in general use in many nonferrous shops, a description of molding some castings produced should be of interest. Fig. 4 shows the cope, drag cheek and casting for a lamp shade frame cast in brass. Due to the flare at the bottom and where the top joins the sides, a three part mold is needed to cast the frame. The pattern was made in four parts and consists of the pyramidal ribs and side pieces which form the top. These fit over a wooden, removable form which prevents sand falling into the center when the cheek is made. In other words the two forms mentioned when placed in position will make a solid pattern when the top and side sections are put in position. In making the mold the cope is made first. The two piece pattern constituting the top is placed on a board with the point up. The flask is placed in position and molding sand screened on. Then the backing sand shoveled on, the plug gates put in position and the sand rammed to the proper density. The plug gates are removed and the top struck off. A smooth board is placed on the top and the whole is rolled over. The board which previously was on the bottom is removed and the center part of the two piece pattern is removed, after parting compound is applied to the mold face.

Removal of the center part leaves the ribs and sides forming the top of the casting still in position in the cope. The cheek or middle flask is then placed upon the cope and the two piece pattern forming the lower part of the casting is fitted to the rib section in the cope. Sand is sifted in and tucked against the pattern. More sand is put in the cheek and the tucking operation is repeated so that the sand is placed snugly against the flaring portion of the pattern which later forms the bottom of the casting.

After shaking on sufficient parting compound, the center portion of the second pattern is removed and the drag flask placed in position. Similar to the previous operation, the thin parts forming the uprights and bottom of the casting still remain in the mold. This leaves a large hollow portion in the center and the drag

(*Concluded on Page* 888)

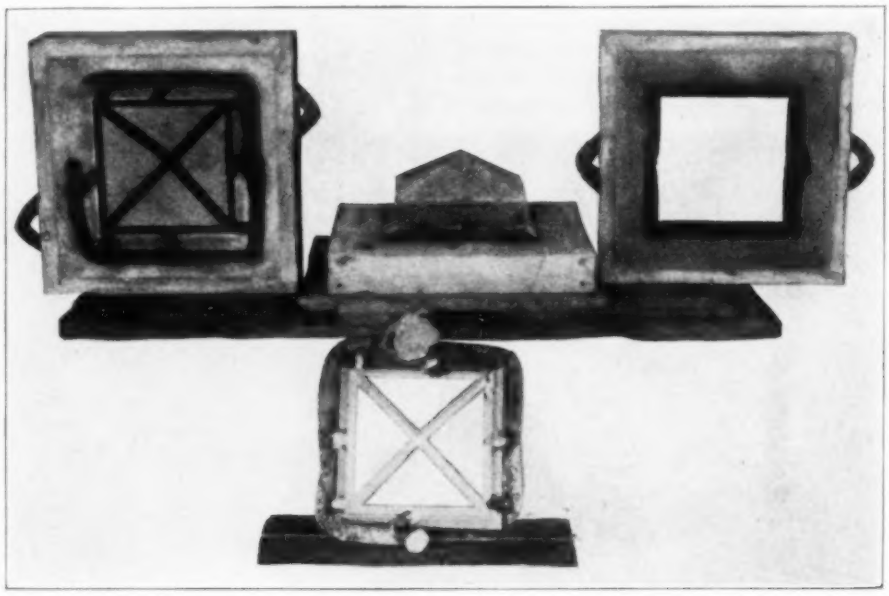


FIG. 4—PROJECTIONS ON THE BASE AND TOP OF THIS LAMP SHADE CASTING NECESSITATE THE MOLDING IN A THREE-PART FLASK WHICH IS SHOWN JUST BEFORE CLOSING

PRESSURE

By Sam Tour

DIE CASTING ALLOYS

Must Meet Requirements

ZINC in aluminum alloys causes hot shortness. In pressure die casting it must be kept low in proportion to the nature of the casting being made. In some cases as little as 0.25 or 0.5 per cent will ruin the alloy; in other cases as high as 1.25 to 1.50 per cent is permissible. In so far as is known zinc in percentages up to 1.5 per cent is not harmful to the mechanical properties of the finished casting. There is some indication that this amount in copper-aluminum alloy is beneficial in that it increases strength and machinability at room temperatures.

Nickel in aluminum alloys in proper percentages is thought by some to increase strength at elevated temperatures, to cut down run marks or flow lines or cold shuts in the finished casting, to cut down the avidity with which the molten metal attacks iron and steel machine and die parts, and to offset to some extent the effects of iron in the alloy. Nickel seems to have the property of increasing the strength and hardness of the finished casting in much the same way as does iron, but without the development of excessive brittleness which would accompany an equal percentage of iron. It also seems to give improved polishing properties and greater light reflectivity to the finished castings.

Nickel does not seem to have the deleterious effects of iron on high-silicon alloys. In short, it is often a solution of a proplem in production, is usually an advantage and seldom the cause of trouble to the consumer.

Affects Properties

VARIOUS impurities in pressure die casting alloys, such as iron, zinc, manganese, magnesium, silicon, tin, etc., affect the physical properties in certain manners. These effects are described in this article. In addition the effects of the impurities are presented in a table to show the impairment or improvement of fluidity, shrinkage, solvent action on iron, etc. The iron content problem is briefly pictured as is the question of hard spots in die castings. This is the concluding part of an article on pressure die casting alloys. The first part appeared in the Oct. 1, 1929, issue.

Nickel may have some effect on corrosion resistance. Nickel plate, for example, seems to promote the corrosion of aluminum, but it is a question whether nickel in the alloy itself has a similar effect. No authentic data are available, but the indications are that it is not nearly so active when alloyed with the aluminum and that in the alloy it is not so active in promoting corrosion as an equal percentage of copper.

Silicon when added to quite a number of aluminum alloys seems to decrease shrinkage and increase ductility at elevated temperatures. An addition of 1 or 2 per cent of silicon or a 1 or 2 per cent increase in silicon content of the alloy often prevents cracked castings in production. No authentic data are available as to the effect of the addition of 2 per cent of silicon to copper-aluminum or copper-nickel-aluminum alloys for pressure die castings. The author has found, however, that such additions have a tendency to harden the alloys somewhat and should be compensated for by a corresponding reduction in copper or copper and nickel content. When such compensation is made, it seems that there has resulted no material change in the mechanical properties of the finished castings.

Iron plays a role in connection with hot shortness and strength and ductility at elevated temperatures. Its use, however, always must be limited by the effect it has on the properties of the finished casting. In many alloys, iron in proper quantities seems to decrease hot shortness and increase strength at elevated temperatures, and to cause the stretching to be distribu-

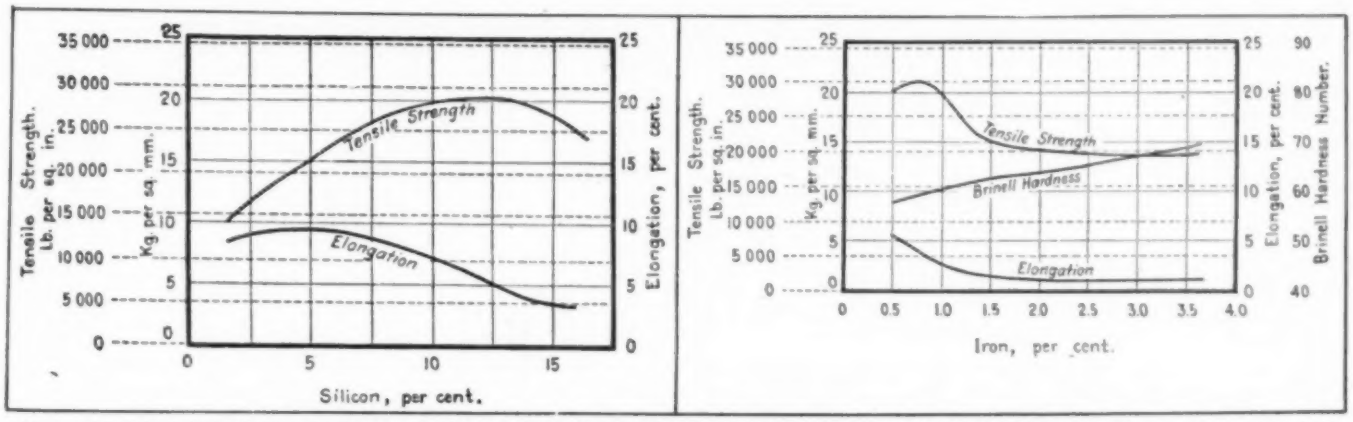


FIG. 1—CURVE SHOWING THE EFFECT OF SILICON ON THE PHYSICAL PROPERTIES OF A 13 PER CENT SILICON, 87 PER CENT ALUMINUM ALLOY. FIG. 2—EFFECT OF IRON ON THE SAME ALLOY

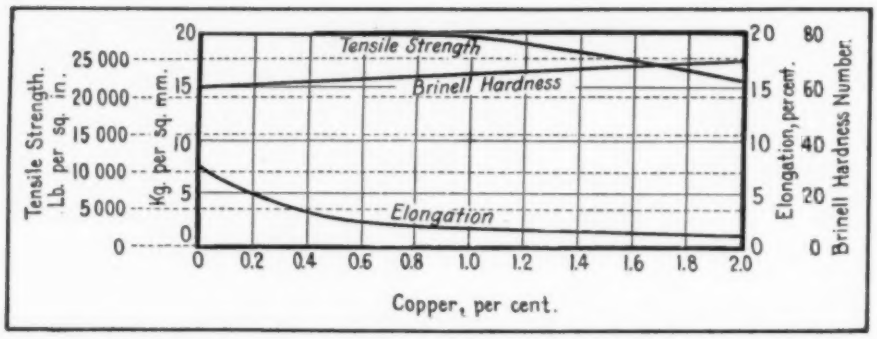


FIG. 3—EFFECT OF COPPER ON PHYSICAL PROPERTIES OF SILICON-ALUMINUM ALLOYS

ted more evenly over the entire casting. Excessive iron, however, sometimes causes hot shortness and brittleness. As other alloying constituents such as copper, nickel, silicon and manganese increase, the maximum and minimum permissible iron content for efficient production of a complicated or difficult casting decreases.

The iron range does not seem to be definite for a given alloy over a large variety of different castings. In practice the producer does not make numerous chemical analyses of castings to locate this range. Analyses are costly and slow and require technical men to interpret them as well as to make them. Iron is controlled usually in the practical way of proportioning the relative amounts of new alloy and remelt used in the casting machine. Sometimes all remelt and sometimes all new metal is found to give best results. This may be an unscientific method of controlling iron but is a practical and efficient one.

Sometimes when large proportions of remelt are necessary in production the final casting is too hard or brittle. This can be corrected often by adding to the remelt some virgin aluminum, thus diluting it and reducing not only the iron content but also the content of the other hardening elements present. The type of alloy used then remains the same as the original alloy, but the iron content has been increased while the content of the other alloying constituents has been decreased. If the desired mechanical properties of the finished casting are maintained there should be no objection on the part of the consumer to such variations in chemical composition.

In a later section of the paper the iron content situation is discussed more particularly from the standpoint of the problems of production.

Magnesium in amounts of 0.10 per cent seems to decrease fluidity, increase shrinkage, cause some additional hot shortness and decrease strength at elevated temperatures. It is, therefore, important from the producer's standpoint that magnesium be controlled carefully. In some castings its presence must be avoided, in others 0.05 per cent is allowable and in others 0.10 per cent. Seldom is it desirable. Magnesium also has a marked effect on the mechanical properties of the finished castings. Initial hardness is increased, some age hardening often results, ductility is greatly decreased. The author knows of a case where the presence of 0.10 per cent magnesium in an alloy of the 4 per cent nickel, 4 per cent copper, 1.5 per cent silicon type made the castings absolutely unfit for the use intended. In many cases 0.05 to 0.10 per cent magnesium will make good surface finish impossible.

Tin decreases the strength and ductility of aluminum alloys at elevated temperatures even more than at room temperatures; in other words it causes hot shortness. This can be overcome partially by the liberal addition of silicon to the alloy, the amount of silicon necessary being usually three times the amount of tin added; but even then the alloy causes trouble due to hot shortness. Tin improves the machinability of aluminum alloys, as discussed in more detail in a later section of the paper presented at the bottom of page 871.

In the accompanying table the author has endeavored to summarize qualitatively the effect of each of the metals ordinarily found in aluminum alloys for die casting. This information is general only and has been gleaned from observation of actual production. In combination of two or more added elements the results are sometimes quite different than are indicated in the table. The effects given in the table are those apparently priduced by relatively small additions of the elements; larger additions often act entirely differently. In a few cases this is shown qualitatively in the table by (— to +), etc., meaning that as the quantity of added element is increased its effect changes.

In this table also are shown col-

Effect of Added Elements on Properties

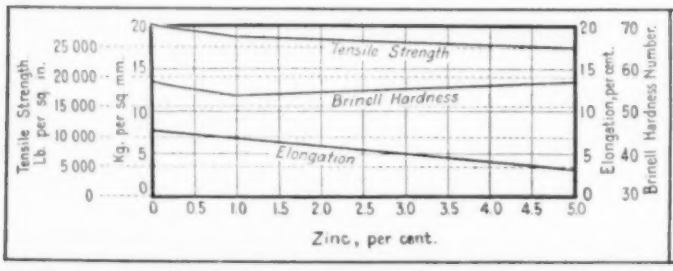
Elements	Fluidity	Shrinkage	Iron Attack	Hot Shortness	Strength at Elevated Temperatures	Machine-ability	Polishing Properties	Plating Properties
Copper	+	—	—	—	+	+ to —	+	+
Silicon	+	—	+	—	+	0 to —	—	—
Iron	—	— to +	—	— to +	+	+ to —	+	+
Nickel	—	— to +	—	—	+	+ to —	+	+
Zinc	+	+	0	+	—	+	—	—
Manganese	—	—	—	—	+	+ to —	+	0
Magnesium	—	+	0	+	—	—	—	—
Tin	+	+	—	+	—	+	—	—

+ indicates an increase in the property with increase in percentage of the element. Thus, fluidity is increased as the percentage of copper is increased.

— indicates a decrease in the property with increase in percentage of the element. Thus, shrinkage is decreased as the percentage of copper is increased.

— to + indicates a change from decrease to increase in the property with increase in percentage of the element. Thus, as the content of iron is increased its effect on shrinkage changes from decrease of shrinkage to increase of shrinkage.

+ to — and 0 to — are to be read similarly.



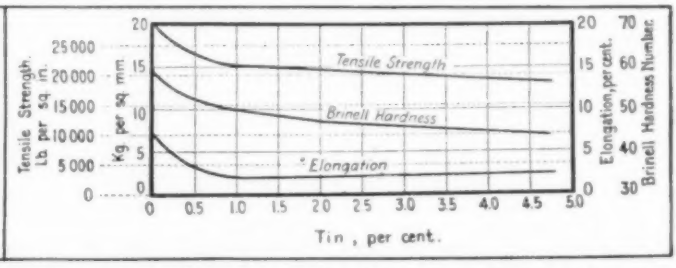


FIG. 4—ZINC DECREASES TENSILE STRENGTH AND ELONGATION OF SILICON-ALUMINUM ALLOYS. FIG. 5—DECREASE IN TENSILE STRENGTH, BRINELL HARDNESS AND ELONGATION OF SILICON-ALUMINUM ALLOYS IS NOTED WITH TIN

umns for machinability, polishing properties and plating properties. After the castings are removed from the die they must go through cleaning and finishing operations. Sometimes this means only the removal of fins and gates by hand sawing and filing, but more often some machining operations are performed; quite often some grinding and polishing, and occasionally plating, operations needed to be performed, as discussed later.

Co-operation Is Advantageous

There is little information on the effects of various added elements on the mechanical properties of the different aluminum alloys, which information greatly is needed. The advantages of co-operative effort in obtaining such data are obvious and tests made in a number of laboratories on castings prepared by different producers in which the percentages of various elements are controlled carefully, would be of the greatest value to die casters.

F. J. Tobias, Newton Die Casting Co., New Haven, Conn., has supplied the curves shown in Figs. 1 to 8, taken from an article by Joseph Dornauf in Zeitschrift fuer Metallkunde, August, 1928. These curves show the effect of silicon, iron, copper, zinc, tin, magnesium, manganese and antimony on the tensile strength, elongation, and in some cases hardness, of the alloy containing 13 per cent silicon, 87 per cent aluminum, as sand cast. Tobias states that he has checked these data in some cases against pressure die castings of a similar composition and has found a close relationship to exist.

While data from these curves may not be applicable directly to pressure die castings, they do show quite conclusively the serious effects of iron, copper, tin, magnesium and antimony, and the minor effects of small amounts of zinc and manganese in line with the previous remarks in this article. Particular attention is called to the reversal of slope at around 0.5 per cent of manganese in Fig. 7 showing the effect of manganese on the 13 per cent of silicon aluminum alloy. Data of similar character for aluminum alloys in the form of pressure die-cast bars would be of great value to the die casting industry.

Machinability is often a source of difficulty with aluminum diecastings. They can be too soft and stringy and therefore difficult to machine. They may be too hard and therefore difficult to machine. They may be full of hard spots which quickly take the cutting edge off the tool. By proper grinding of cutting tools the trouble due to the first two sources usually can be overcome, but scarcely anything can be done in respect to castings so full of hard spots as to act like grinding wheels on the cutting edge of a tool.

There seems to be the general impression that high iron content is the basic cause for all machining troubles. Obviously this is not the case where the difficulty is due to the metal being too soft and stringy, as iron in considerable amounts increases the hardness of the alloys. This is not so obvious in the case of alloys which are difficult to machine due to high hardness. However, practically all alloy additions to aluminum except tin and zinc, and possibly silicon in some instances, increase hardness as it affects machinability. In other words, this difficulty in machining may be due to high alloy content other than iron. For example, 0.2 per cent magnesium often will have as great an effect as 2 per cent or sometimes even 3 per cent iron.

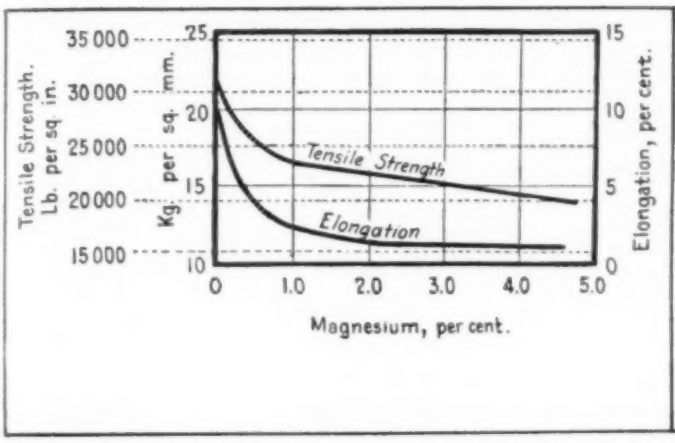
Often hard spots are accompanied by high iron, but is there any direct relation between high iron and hard spots? This depends upon the composition of the hard spots. A simple and quick test can, in many cases, be made to determine if the inclusions are metallic iron, iron oxide, iron silicide, or some other iron compound. If the clean machined surface showing one of the hard spots is treated with a solution of potassium ferricyanide containing a little sodium chloride a blue scum will form in a minute or two over the hard spot if the spot is iron or an iron compound subject to attack by a sodium chloride solution.

Inclusions Form Hard Spots

In a vast majority of cases hard spots are not due to high iron but are simple inclusions of aluminum oxide, dross, or other foreign materials. High iron, however, often accompanies hard spots caused by overheating and long stewing of molten aluminum in an iron pot. By proper fluxing of the metal the hard spots or inclusions usually can be removed and the fluxed metal, although high in iron, will give no trouble due to hard spots. The author, for example, has seen 3 to 4 per cent copper-aluminum alloy containing as much as 6 per cent iron machined without trouble.

Hard spots can be caused by overheating and long stewing of molten aluminum in graphite crucibles where no iron pick-up occurrs. They may be carbides, silicides, clay, sand, brick or any of a number of things. They may be direct evidence of poor alloying practice in the addition of metallic silicon or hardeners to the aluminum.

Tin and zinc both increase machinability of aluminum alloys. Tin is much more effective than zinc, and acts apparently similarly to lead in brass alloys. The addition of only 0.5 per cent tin often is sufficient to give free machining properties. Sometimes more is needed, and the author has seen aluminum die castings made with tin as high as 4.0 per cent. The advantage gained by additions of tin beyond 2.0 per cent are slight as re-



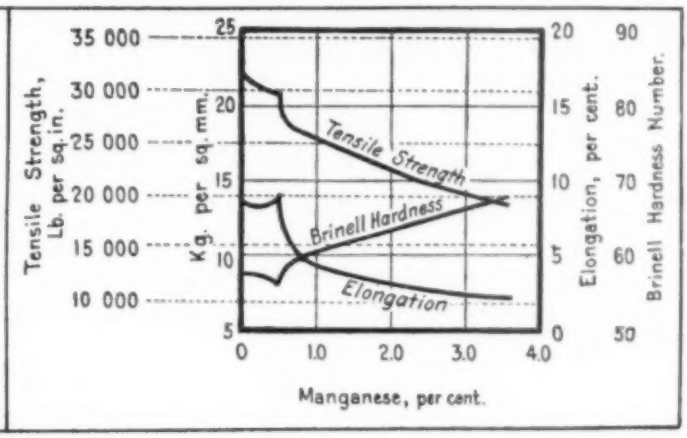


FIG. 6—MAGNESIUM LOWERS THE TENSILE STRENGTH AND ELONGATION OF 13 PER CENT SILICON AND 87 PER CENT ALUMINUM ALLOYS. FIG. 7—EFFECT OF MANGANESE ON THE SAME ALLOY

gards machining, while the disadvantages as regards casting properties of the alloy become considerable.

Polishing properties are important in many instances. Soft metal is much more difficult to polish than hard metal. Luster and reflecting power of the polished surface vary with the composition of the metal. Silicon deadens the luster and decreases reflectivity, as also does tin. Copper, nickel and iron all improve polishing properties, brighten the luster and increase reflectivity. Porosity (blow-holes and sponginess) and hard spots are ruinous to polishing properties. Magnesium seems to be harmful to polishing properties; manganese seems to exert a beneficial effect.

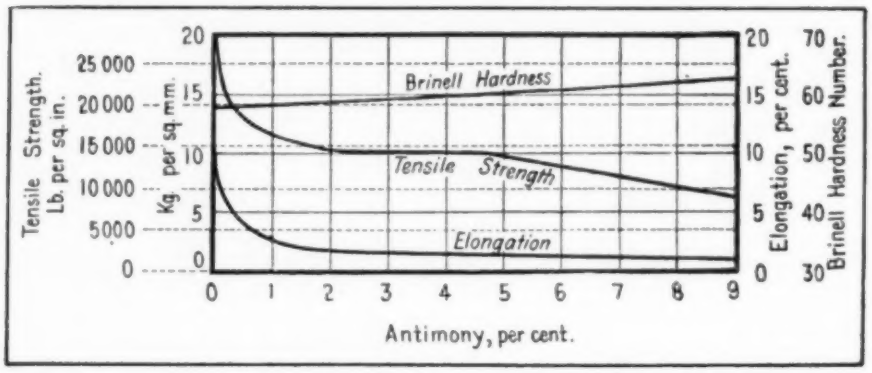


FIG. 8—EFFECT OF ANTIMONY ON A 13 PER CENT SILICON AND 87 PER CENT ALUMINUM ALLOY

Nickel plating of certain aluminum-base die castings has been a quite regular practice for a number of years. Corrosion resistance and appearance have been the object sought. More recently cadmium plating for corrosion resistance alone has become fairly common practice. At present several companies are attempting to chromium plate over copper and nickel with more or less indifferent results. Considerably more experience must be had before much can be said about the relative properties of different aluminum alloys as regards cadmium and chromium plating. In nickel plating it seems that copper, nickel and iron additions, in the order named, improve plating properties, while silicon, zinc, magnesium and tin are detrimental.

Iron Content Situation

The problem of using up scrap, gates and runners is a vital one in the pressure die-casting industry. As explained before, every time the alloy goes through the process certain impurities are picked up, mainly iron to the extent of 0.5 per cent. Sometimes the weight of gate plus runners plus overflows and fins will be ten times the weight of the finished casting, while in some cases it may be as low as one-half or one-third. The average ratio of weight of finished castings to total weight of metal actually cast is of the order of 1 to 3. This means that the finished castings are made of metal which has been through the casting machine an average of three times. This means that three times 0.5 per cent or a total of 1.5 per cent of iron has been picked up. This added to the original 0.5 per cent of iron as an impurity in the metals used, plus the 0.3 per cent picked up in alloying in iron pot furnace practice, means a total average iron content in finished castings of 2.3 per cent. A high iron content is obviously inherent in the process.

By use of refractory-lined alloying furnaces, the iron pick-up due to alloying can be eliminated. By careful control of casting temperatures and gating and venting so as to permit of as low casting temperatures as possible, the iron pick-up in the process might be reduced to 0.4 per cent or even as low as 0.3 per cent per operation. By a redesign of casting machines and development of better die steels, gates and runners could be made smaller and shorter and the average ratio of weight of finished castings to weight of metal cast might be brought down to 1 to 2.

The result of all these combined would be an average iron content of finished castings of 1 to 1.15 per cent. But these improvements have not yet materialized. Refractory-lined furnaces for alloying are being adopted gradually but are by no means universally used in the industry. Not much is being done in respect to gating and venting as related to casting temperatures. Redesigning of machines and replacing of equipment is a slow process. Under present conditions, therefore, we must expect an average iron content of 1.75 to 2.0 per cent as an optimum in finished aluminum pressure die castings.

However, this iron content is too high for certain alloys, such as the high-silicon alloys and for certain special castings. Every die casting company has certain customers who specify low iron content in their castings, and who even demand that only new metal—no gates or scrap—be used on their work. These same customers usually refuse to consider paying an additional charge for this purity of metal. If say 20 per cent of production has iron below 1.5 per cent, say an average of 1.3 per cent, the result is that the remaining 80 per cent of production must average 2.5 per cent of iron.

This is rather a startling picture of the iron content situation as faced by the aluminum pressure die-casting industry, but it is not at all hopeless. Certain additions to silicon-aluminum alloys, for example, have been developed recently which seem to counteract or neutralize the effects of iron on these alloys. They are being tried out, although they have not yet come into general use. A partial separation of iron from molten aluminum alloy takes place on slow cooling and freezing.

A high iron-bearing sludge settles to the bottom and on careful remelting and pouring off, some 80 per cent of the alloy can be recovered containing only about 1.25 per cent of iron. The remaining 20 per cent is a molten alloy still rather high in iron plus the sludge which may run from 10 per cent up to as high as 25 per cent of iron. This method of treatment requires special large furnaces, is costly and time consuming. The high-iron-bearing sludge has no ready market and represents a considerable direct loss in metals to the producer. In the present day of keen price competition, the adoption of such processes is naturally very slow.

The proper picture of the iron situation might be summed up as follows: The average iron content of aluminum alloy pressure die castings can be expected to be slightly above 2 per cent. If a maximum of 2 per cent permissible iron is set, a slight premium should be paid for metal purity. If the maximum is set at 1.5 per cent, a considerable premium should be paid for metal purity.

Set Safety Record

Lewistown Foundry & Machine Co., Lewistown, Pa., with an average employment of 30 men, had worked 594,000 man-hours without a lost-time accident at the time the record was reported to the department of labor and industry of the state of Pennsylvania. E. Cross, plant superintendent, is in charge of the safety campaign.

Producing Steel Castings in the Modern Foundry

Part X

By Charles W. Veach

ALTHOUGH none of the materials used in the molding department find their way into the product, their utility is an important factor in molding economy. Moreover, the sand, cores, etc., play an important part in shaping the physical characteristics of the castings which owe their form to the finished mold.

A mold that has been made of sand that is too wet, is not a fit receptacle for metal heated to about 2900 degrees Fahr. Castings poured in such molds will have a rough surface and small gas cavities under the surface will cause the casting to be rejected. This is only one of the many factors of sand preparation which must be watched closely. In continuous work where the sand is returned to large storage hoppers as soon as shaken out of the flasks, there is danger of it being tempered while it is too hot if the cycle moves too fast. If elevated to the hoppers while in a heated condition, it cools slowly as sand is a poor conductor of heat.

Outlines Foreman's Duties

Sand control is one of the major problems of the foreman of the molding department. Sand constitutes the largest item of his raw materials. Next in importance are cores, which the molder foreman considers as semi-raw material and he should have authority to reject them if they do not meet his requirements. If there is close co-operation between the core department and the molding department, there will be few occasions for rejection of cores. Where unfamiliar work is undertaken the heads of those departments should confer frequently with each other until the work is established on a production basis. A large force of molders is employed in a steel foundry making from 150 to 300 tons of castings each day. Organizing this force and keeping them supplied with suitable materials and tools so that they can work efficiently is no small task. There are certain functions which are the molding department foreman's duty to perform. These are the major functions of the department. The foreman must shoulder detail on his assistants.

Co-ordinates Operation

An important function belonging to the foreman of the molding room is to coordinate the operations within the department so that delays are kept low. Materials should flow in a constant stream, and the molds move out as fast as they are made and closed. Looking to the betterment of the working conditions of the men in his department is clearly one of the department head's major functions. If working conditions are improved, it will be found invariably that costs are reduced, supervisory duties are made easier and better castings are produced.

The superior knowledge of the mold-

Explains Defects

MOLDING operations probably are responsible for more defects in castings that any other step of the casting process. The causes and remedies for many molding troubles are explained by the author in this, the tenth of a series of articles on the production of steel castings in the modern foundry. The duties of the foreman of the molding floor also are discussed. Responsibility for defects is delegated and the subject of cracks is treated from the viewpoint of both the melting and the molding departments.

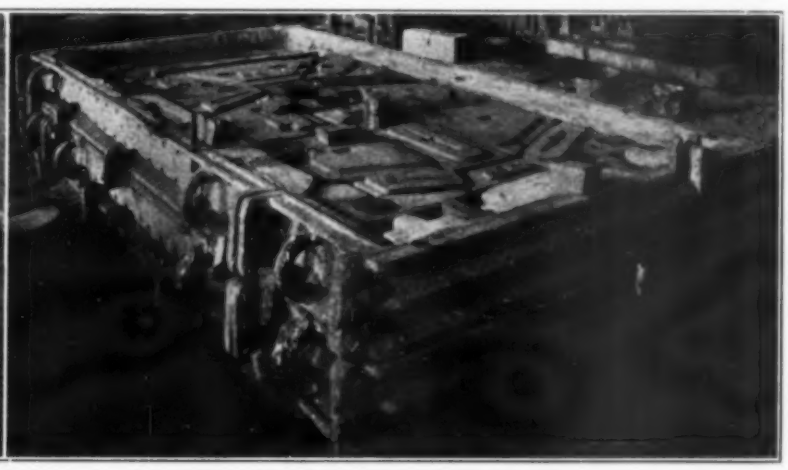


FIG. 16—MOLD FOR ANCHOR CASTING AFTER IT HAD BEEN DRIED AND BEFORE THE CORES WERE SET. FIG. 17—A LARGE NUMBER OF CORES ARE USED IN A STEEL FOUNDRY. NOTE THE NUMBER REQUIRED FOR LOCOMOTIVE CRANE BASE

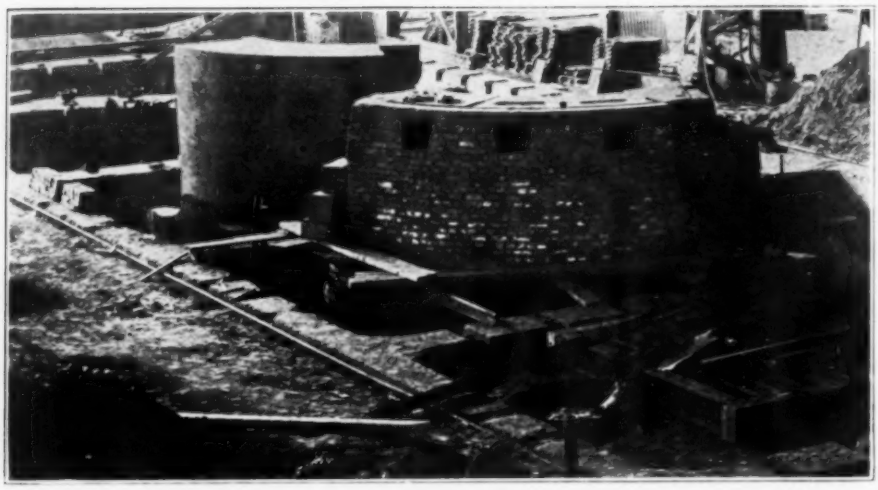


FIG. 18—PIT MOLDING OFTEN IS USED TO MAKE LARGE STEEL CASTINGS

er foreman should be utilized in all particular work. He should keep abreast of the times by studying technical matter published by technical, business and trade papers, by attending lectures and by making frequent visits to progressive foundries. Then when he discusses the technical phase of the work with his assistants and imparts to them the knowledge he has gained, they will apply what he has taught them to the work in progress.

It is a difficult task to keep a jobbing molding floor in such order that the ladle does not have to be taken from one spot to another while the heat is being poured. If the ladle can be moved in a straight line, it will be better for the metal lying underneath the slag, for it is generally accepted that the longer the metal is held in the ladle the more silicon and manganese will be lost to the slag and the more phosphorus and sulphur will be taken up by the metal.

The author does not subscribe to this theory and is of the same opinion that he expressed in an article in *Iron Trade Review*, July 15, 1920. However, if a heat is held unduly long in the ladle, the melter must get his metal extremely hot, or occasional sculls will result. In addition to that disadvantage, spotting the molds in an unorganized manner gives the appearance of sloppiness, and tends toward disorder.

A jobbing foundry will appear disorderly to the man accustomed to conditions in a foundry specializing in continuous work and employing machines which have fixed locations. In the latter, the molds usually are lifted from where they are closed and either spotted in a row in the center of the room or transported to a separate pouring bay. Under this arrangement, the molds may be taken from the vicinity of the machines as fast as they are closed and clamped. In that type foundry, molds are poured easily without moving the ladle all over the shop.

A list of defects commonly found in steel castings will disclose that the largest variety of defects are traceable to molding. Such a list is given in Table II.

Responsibility for several of the defects listed under molding rests with the subforemen whose duty it is to supervise molding operations. Some can be traced to the materials, therefore the head of the department is responsible. However, if drop-outs, scabs, core blows, and wet sand are due to inadequate facilities for preparing the sand, or to the policy of purchasing low grade material, and the head of the department has shown his superiors by written reports how improvement can be made, then the responsibility for losses rests on the management.

Table II

Lists Causes

Defect	Attributable To
Cracks	Melting or Coremaking
Miss-runs	Melting, Molding or Pouring
Porosity	Melting
Dropout	Molding
Scab	Molding
Core Blow	Molding or Coremaking
Crush	Molding
Shift	Molding
Poor Core Setting	Molding
Core Left Out	Molding
Wet Sand	Molding
Swell	Molding
Poor Gating	Molding
Run Out	Molding
Broken Core	Molding
Hollow	Molding
Strain	Pouring
Slag	Pouring
Core Cut	Coremaking
Wrong Dimension	Pattern
Gas Pocket	Coremaking
Core Drop	Molding
Core Rise	Molding

FIG. 19—LOWERING A FLASK ON A MOLDING MACHINE USED TO RAM MOLDS FOR RAILROAD CASTINGS

Cracks have not been placed in the list of defects chargeable to molding. If the castings have a tendency to crack, and most steel foundries experience this trouble to some extent, the molder foreman has it within his power to keep that loss low. He can refuse to use cores which he knows by experience will aggravate the cracking tendency and he can control the sand mixture and ramming of the molds so that the sand will not be packed so hard that the metal cannot contract naturally.

Design often is such that where

care is exercised in the molding operation and nothing appears wrong with the metal, the castings crack. This is particularly true where thin sections project from heavy sections causing uneven strains. This difficulty sometimes is overcome by using chills or cracking strips. Each pattern should be studied before it is put in the sand to discover any possible weak points when the metal shrinks. Steps should be taken to prevent loss from cracks. After a particularly difficult job has been produced successfully, a history of the work should be made from notes taken while the work is in process and this record filed where the foreman can consult it if he should be called upon to produce the work again.

Some foundries charge all cracks against the metal regardless of how carefully the heats are worked or of the fact that chemical analysis shows the metal to be free of excessive amounts of impurities. Indeed, a few are so deeply set in this belief that they are not much impressed even when a careful study of micrographs reveals a metal almost free of inclusions.

Charges Losses

A certain large, steel foundry has what it considers a clear cut method of placing the responsibility for various defects which are serious enough to cause a rejection. That foundry charges half of the defects resulting from cracks to the molding department and half are charged to the melting department. This arrangement prevails when only one or two castings crack on a heat. When several of each design show cracks bad enough to spoil the casting the loss is charged to the melting department. Usually careless work, or some accident occurring to make a bad condition under which the heat was refined will show that the metal might be blamed. However, if several designs of castings are poured and one particular design cracks, it cannot be the fault of the metal, and must be either the design or the cores that are at fault.

The author recently discussed the question of cracks with a producer of high class work who uses the electric furnace for melting the metal. His foundry makes housings for motor trucks in large numbers. When asked if he encountered any difficulty with cracks, he replied that if he used cores which did not collapse easily the housings would crack badly.

The bottom half of the core used in making the housing is green sand. If too much clay is used, or if the sand is rammed too hard, cracks will result. If the green sand cores are responsible for the trouble, it is up to the man in charge of molding operations to remedy the situation. If the cores coming from the coreroom cause the trouble and this department is under the supervision of another man, the molder foreman only can register his protest against being furnished with a material which is unsuitable. Having done this the responsibility now must rest on shoulders other than those of the molder foreman.

A core which is made of good sand, has the proper core compound, is rammed and then baked thoroughly, should not blow. Good cores will blow when the green sand adjacent to them are too dense or if the sand is rammed too hard, closing up the channels for the escaping gas. An experience of this kind was brought to the author's attention about 23 years ago when castings for railroad equipment first were introduced. Trouble was experienced with a truck bolster weighing about 1000 pounds.

Green sand was used to core the casting. This green sand core was rammed by hand, then before the metal frame was withdrawn, impressions for a core to form the bearing for the body bolster were made with blocks of wood fashioned to the shape of the cores. Heap sand was used to make the green sand core, and it seems that hammering down the impression block packed the sand too close. Many castings were spoiled by blows before steps were taken to eliminate the difficulty.

After many remedies had been tried to no avail, the finisher scraped away a goodly portion of the under side of the offending core. This made a cavity in the part of the core that rested on the green sand core. When the molds having the cores so treated were poured off not a single blow occurred. This expedient was augmented by ramming up two iron bars in each end of the green sand core.

FIG. 20—MANY SMALL STEEL CASTINGS ARE MADE ON MOLDING MACHINES

To keep molding defects down to a minimum, constant watchfulness on the part of the department head and his assistants is required. In production shops where nonskilled labor is used, supervision is more difficult than it is in jobbing shops where each molder is a skilled craftsman. In the latter case conditions ought to improve as the apprentice movement gains favor. It is evident that the modern method of apprenticeship training is turning out workmen who are better informed in the technical phase of foundry work than the average molder has been in the past.

National Safety council, 108 Ohio street, Chicago, has issued a bulletin on industrial eye hazards. It outlines the causes of eye injuries and describes treatment for them.

Questions & Answers on FOUNDRY PRACTICE

GRAY IRON

Prevent Chill on Hubs

QUESTION

In making small car wheels we find that on some days the hubs are machinable while on other occasions the top of the hub next the core is chilled to a depth of approximately 1/16-inch and cannot be machined. Even on the same day we find variations in the castings and from 5 to 30 per cent of the hub tops are chilled. Can you suggest the cause, also a remedy?

ANSWER

Gray iron of a suitable composition for making chilled castings is extremely sensitive to slight variation either in the method of mixing and melting the iron or in the manner in which the mold is made and poured. Variation of the chemical composition of the scrap in the charge may cause a variation of 20 or 30 points in the silicon content in the casting. We suggest you take a chill test from each ladle and with this for a guide you can readily manipulate the iron in the ladle if necessary before it is poured into the castings. The chill test is only comparative and must be determined by experiment to suit local conditions. Have a small wood pattern prepared 1 x 2 x 4 inches and make several open sand molds with an iron plate for a bottom. Pour one of these with a hand ladle and cool it in water immediately after it has become fit to handle. Then break it and observe the depth of the chill. Note the character of the castings poured from the same ladle. If they are satisfactory then it is apparent that iron with the same chilling properties is the kind required in subsequent ladles. Your problem is simplified since you only have to soften the iron in the ladles slightly where the test bars show too deep a chill. This can be done by a small addition of ferrosilicon or nickel. The exact amount must be determined by experiment. A complete description of the methods, materials and processes used in the manufacture of chilled car wheels appeared in THE FOUNDRY in six consecutive issues April to June 15, 1920, inclusive.

THIS department covers all problems relating to metallurgical, melting and molding practice encountered in making steel, malleable-iron and gray-iron castings. Questions submitted by bonafide subscribers to this department will be answered by members of the editorial staff of The Foundry, supplemented where occasion requires by the advisory staff whose personnel is as follows:

John H. Hall—Cast Steel
H. A. Schwartz—Malleable Cast Iron
J. W. Bolton—Gray Cast Iron

All questions should be addressed to The Editor, The Foundry, Penton Building, Cleveland.

Q & A

Valve Seats Pit

QUESTION

For several years we have been making castings for diesel engines using the following mixture: Low silicon pig iron, 800 pounds; charcoal pig iron, 200 pounds; high manganese pig iron, 200 pounds; steel, 400 pounds; return scrap, 400 pounds. This gives an analysis in the casting as follows: Silicon, 1.60 per cent; sulphur, 0.12 per cent; phosphorus, 0.40 per cent; manganese, 0.60 per cent; total carbon, 3.26 per cent. Recently the valve seats in some of the cylinder heads (weight about 300 pounds) have shown signs of pitting which requires regrinding in about 3 months. The consumer claims that another make of casting will go 9 to 12 months without regrinding. Can you tell us what causes this pitting, and can you suggest any other mixture which would be more suitable?

ANSWER

Four requisites that diesel engine castings should possess are: Strength at elevated temperatures; solidity; maximum resistance to wear, and minimum growth under the temperatures involved. According to Coyle, *Transaction*, American Society for Steel Treating, 1927, a specification by the navy yard for three different types of diesel engines met the previously mentioned requisites successfully. The analysis given is: Total carbon, 2.95 to 3.20 per cent; manganese, 0.30 to 0.50 per cent; phosphorus, under 0.20 per cent; sulphur, under 0.12 per cent; silicon, 1.00 to 1.30 per cent. Iron of this analysis may give hard corners or edges in green sand castings where the thickness is under ⅞-inch.

An English maker of diesel engine castings gives the following analysis for cylinder liners: Silicon, 0.95 per cent; manganese, 0.70 per cent; phosphorus, 0.18 per cent, sulphur, 0.11 per cent, total carbon, 3.19 per cent. The mixture used to obtain such an analysis consisted of 224 pounds steel scrap; 224 pounds No. 2 Scotch pig iron (Si, 2.3 per cent; P, 0.4 per cent; Mn, 1.0 per cent); 112 pounds No. 4 hematite, high manganese pig iron (Si, 1.4 per cent; P, 0.03 per cent; Mn, 2.1 per cent), and 224 pounds cylinder scrap (Si, 0.93 per cent; P, 0.23 per cent; Mn, 0.6 per cent). This iron was cast in dried molds shortly after removing from the oven, and while still hot.

You can see by a comparison of your analysis with the two given that your silicon and phosphorus are considerably higher. Therefore it is suggested that you substitute malleable bessemer pig iron for your low silicon iron to reduce the phosphorus to 0.2 per cent or lower. This will give an iron that will withstand impact from explosion much better than your present cast iron. Also your silicon can be reduced to conform with the analyses presented. You can increase your steel scrap addition up to 40 per cent with advantage. This will reduce the carbon and silicon simultaneously. With proper regulation of cupola operation and correct steel additions

you can get your carbon down to 3.0 per cent. If any chill is encountered through low silicon, an addition of 0.5 to 1.0 per cent nickel will decrease this tendency. Your silicon should run between 1.00 and 1.25 per cent. Joint reduction of silicon and carbon will produce a close-grained iron which will stop pitting to a large extent. With high steel mixtures, hot iron and good mixing of the iron before pouring is necessary. Proper feeding also is necessary.

While we cannot state the exact cause of pitting of the valve seats, a number of factors that may be responsible are: Grit in the fuel, dirt and scale in the air and fuel piping, scale or gritty ash formed from combustion and blown against the seat under high pressure, fire cracks in the valve face which form leak paths and the cutting action of the burnt gases enlarges them. Sulphur in the fuel also causes considerable pitting as it forms sulphuric acid during combustion. The acid corrodes the seat, not so much while the engine is running as when it is idle which allows the acid to condense on the seat and attack it.

Q & A

Deeper Chill Wanted

QUESTION

We are making a cast iron block approximately 12 inches square, 5 inches thick with one face flat and one face curved. The curved face must be chilled to a depth of ¾-inch and the flat face must be machinable. We are making the mold in green sand with the curved face against a chill 4½-inches thick in the drag. We use 600-pound charges in the cupola and make up a special charge for a few of these blocks as follows: Steel scrap, 175 pounds; pig iron, 175 pounds; malleable pig iron, 250 pounds. The first is a special pig iron containing small amounts of chromium and nickel with the ordinary elements as follows: Silicon, 2.10 per cent; sulphur, 0.03 per cent; phosphorus, 0.40 per cent; manganese, 0.77 per cent. The malleable pig iron is of the following analysis: Silicon, 0.88 per cent; sulphur, 0.04 per cent; phosphorus, 0.19 per cent; manganese, 0.55 per cent. What is wrong with that mixture and how must it be changed so that we can secure the necessary depth of chill?

ANSWER

A great many factors must be taken into consideration in making chilled castings including the size and shape, the purpose for which they are intended and the character of the materials available in the stockyard. The basic factor is that the silicon content must be varied in proportion to the thickness of the section. For example, the mixture you are using would show a chill almost all the way through in a plate 1-inch thick, but will not chill more than approximately ¼-inch deep in a block 5 inches thick. According to the analysis given the iron in the casting has a silicon content of slightly over 1.00 per cent when it should not be over 0.50 or 0.60 per cent. The obvious remedy is to reduce the silicon in the charge and this can be done in a number of ways, either by increasing the amount of steel or by substituting malleable or white iron scrap for a certain amount of pig iron. A temporary expedient for increasing the chill on odd castings is found by blowing sulphur in through the tuyeres in the cupola. However, at best this is a haphazard method and only employed in an emegency.

STEEL

Heat Treatment of Alloys

QUESTION

What method is used in removing risers from chromium irons and steels, and nickel-chromium alloys? Have you any data on the heat treatments for these alloys?

ANSWER

Most of these metals cut slowly with the gas torch, and many of them machine with such difficulty that it is not possible, or at least not economical to remove the risers with the old-fashioned slow moving cold saw. They can be removed readily with either a thin abrasive wheel or a high-speed saw of the type used in cutting rails and structural material to length. The latter method, however, is difficult to carry out, because of the necessity of holding the castings firmly so that the saw will not jam and break. Castings of complicated shape are naturally difficult to hold down on the bed of one of these saws.

The heat treatment of the stainless steels is generally a plain quench in water or an air cool from a comparatively high temperature, some 1750 to 1900 degrees Fahr. with the object of maintaining the metal more completely in the austenitic condition than is possible in the untreated material. No drawback is used following the quench, except sometimes one at a low temperature for the purpose of relieving the quenching stresses as much as possible without affecting the rust-resisting properties of the metal. The Ni-alloys are sometimes similarly treated, sometimes used in the cast state. There are an enormous number of patents applying to the various stainless steels and nickel-chromium alloys many of which include the heat treatment of the steel to render it as rust-resisting as possible. In considering the manufacture of these metals, the patent situation should not be neglected, to avoid the possibility of difficulty with the owners of patents.

GENERAL

Stack Plow Point Molds

QUESTION

Some time ago I read in THE FOUNDRY of a plant where molders make from 275 to 300 plow points for a day's work. I should like to have details on the manner in which they are equipped to do so. Are the molds made in snap flasks, do they place more than one pattern in a flask and are the flasks stacked? I am thinking of placing some car wheel scrap in my mixture for these castings to produce a good chill. What percentage should I use to get the maximum hardness without brittleness. Should the castings be annealed?

ANSWER

A complete illustrated description of the manner in which all plow castings in addition to many others are made at the plant of the Vulcan Plow Co., Evansville, Ind., appeared in the Nov. 1, 1920 edition of THE FOUNDRY. Briefly the method for making the plow points is as follows.

Two pattern plates, one containing the drag side of the pattern and the other the cope side are mounted side by side on a hand squeeze machine in such a manner that a single pull on the lever forms the two halves of the mold. Two plow point castings are made in a mold. The flask is nearly three-corner in shape instead of rectangular, to conserve sand. The cope is provided with a small pocket on the outside at one end to contain the runner. The cope is 5 inches deep and the drag is 2½ inches. The joints are planed in all instances. The pattern plates are mounted on suitable stands about 8 inches above the regular table of the machine to provide room for the stripping device attached to the *undercut* flange part of the drag pattern. A lever on the side of the machine strips the flanges through the plate before the drag is lifted from the machine.

The flasks are stacked five high and are poured from a one-man ladle that just holds sufficient metal to pour the stack. The ladle is suspended from a monorail by a special device made up principally of a quadrant arm, a ratchet tooth and a notched steel bar by which the operator easily may raise the ladle successively from the lowest to the highest mold in the stack.

The amount of car wheel scrap which you may use in the mixture naturally will depend on the character of the other available irons you may have in your yard. We suggest you start with 10 per cent and gradually increase the amount until you arrive

at the apparent maximum. A good chill on these castings is secured from iron with a silicon content of 1.20 per cent. The castings are not annealed.

Q & A

Fan Blower Is Too Small

QUESTION

We are contemplating increasing the diameter of our cupola to 30 inches so that we can melt from 2½ to 3 tons per hour. Our present fan is 26 inches diameter outside with a discharge nozzle 8 inches outside diameter. What total volume of air is this fan capable of delivering? Also at what speed should this fan be driven to deliver the correct volume of air?

ANSWER

Your fan is too small to supply sufficient air to keep a 30-inch inside diameter cupola melting to capacity. By way of demonstration it is possible that the fan might be speeded to a point where it would deliver 90,000 cubic feet of air per hour, but that speed is not commercially feasible. It would entail the service of an abnormal motor and eventually would wreck the fan. The pressure also would be too high resulting in an excessive loss of silicon and the production of castings much harder than an analysis predicted on the composition of the charge would indicate.

For a 30-inch cupola you require a fan with at least a 10-inch outlet and a capacity of delivering approximately 90,000 cubic feet of air per hour against a pressure of from 8 to 10 ounces. The ideal blower is one that will deliver the required volume of air at a comparatively low pressure.

Q & A

Cement for Mold Facing

QUESTION

I will appreciate any information you can give me on the subject of dusting cement on the face of a green sand mold.

ANSWER

Cement is employed to some extent in several foundries to take the place of the usual blacking dusted or brushed on the face of green sand molds. It presents no advantage over facings that have come to be regarded as standard and it carries the distinct disadvantage that if it is used in considerable quantities it will ruin the sand heap by destroying its porosity.

In practically every instance where it is employed its use was first induced by the necessity of preventing a certain casting from scabbing or for preventing the sand from washing from in front of the gates. A little cement dusted over the surface formed a dry skin that resisted either the slight tendency to scab, or the erosion from the flowing stream and immediately after the manner of the ordinary foundryman the remedy was regarded as marvelous and the practice forthwith adopted as standard. Foundry practice is filled with instances of this character where methods and materials are used without any definite knowledge on the part of the workman as to why he uses them in preference to others. As a remedial measure or as a precautionary measure in the preparation of a mold for certain purpose the use of a cement coating is not objectionable, but its indiscriminate use is not necessary and as formerly stated it exercises a deteriorating effect on the sand pile by eventually closing passages between grains.

Q & A

Must Slag Cupola

QUESTION

We are melting from 4 to 6 tons of iron per day in a cupola lined to 28 inches in diameter, but experience considerable trouble on account of a bridge which forms above the tuyeres, retards the melting speed during the second part of the heat and finally stops melting altogether. We use 600 pounds of coke on the bed on which we charge 500 pounds of scrap. Succeeding charges are made up 80 pounds coke to 500 pounds of iron. We place 40 pounds of limestone on each charge after the second. Air is supplied by a positive pressure blower with a rated speed of 365 revolutions per minute and a delivery capacity of 1550 cubic feet per minute. Is this the proper blower for our cupola? The lining in the cupola cuts to such an extent that we have to re-brick it every month. We have tried changing the height of the bed also the relative weight of the charges without result. We shall appreciate your opinion on the cause of our trouble.

ANSWER

The speed and delivery capacity of the blower are approximately correct for a 28-inch diameter cupola. Your coke and iron ratio should produce hot iron at high speed and therefore the only apparent cause of the trouble lies in the fact that the slag is not drawn from the cupola as fast as it accumulates. A 6-ton charge made up of 500-pound charges means 24 separate charges and while the slag produced by each charge does not amount to much, still in the aggregate it is sufficient to choke the cupola if it is not removed. You may not be using a sufficient quantity of limestone, or you may be using limestone of an inferior quality to produce a liquid slag. The only function of a flux is to refuse material incident to melting to a liquid state and if it does not do that, it only aggrevates the condition it is supposed to relieve. We suggest you operate a slag hole about 4 inches below the tuyeres and flux the charge liberally either with limestone or one of the special fluxes prepared by manufacturers whose advertisements appear in THE FOUNDRY.

MALLEABLE

Makes Cupola Malleable

QUESTION

We are contemplating the production of malleable cast iron on a small scale, and would like some information on the subject. Is the melting done in a regular gray iron cupola? Have you any data on annealing practice?

ANSWER

Malleable cast iron is produced in the cupola for such castings as small pipe fittings, etc. Under suitable control conditions cupola malleable should have around 40,000 pounds per square inch tensile strength and an elongation from 6 to 10 per cent in 2 inches according to L. E. Gilmore, in the Nov. 1, 1927 issue of THE FOUNDRY. A 36-inch inside diameter cupola will melt about 4 to 4½ tons per hour. The tuyeres may be about 18 inches above the bottom and the slag hole about 13 inches. Blast pressure ordinarily runs from 8 to 16 ounces and the bed should be from 41 to 51 inches above the top of the tuyeres. A mixing ladle with a capacity of 3000 pounds will assist in giving uniform iron for pouring. Charges for a 36-inch cupola should be 1000 pounds and the coke to iron ratio 1 to 6. The cupola should be slagged with limestone using about 15 to 20 per cent of the weight of coke in the splits. A typical charge consists of 40 per cent sprues; 20 per cent malleable scrap; 20 per cent malleable bessemer pig iron; 20 per cent steel, and about 15 to 30 pounds of spiegel to raise the manganese between 0.55 and 0.65 per cent. Melting loss in silicon averages around 0.10 to 0.15 per cent; manganese from 0.15 to 0.25 per cent; phosphorus remains the same and sulphur will increase from 0.06 to 0.12 per cent. Annealing is done in pots which are sealed to the furnace atmosphere. Packing may or may not be used. One cycle is given as heating to 1750 degrees Fahr. in 16 hours; holding at this temperature for 24 hours; cooling to 1100 degrees Fahr. in 60 hours and then removing the oven door. Another cycle that gave good results was: Heat to 1600 degrees in 16 hours; holding for 30 hours at this temperature as previously mentioned.

The FOUNDRY Family Photograph Album

Upper Left

L. J. PURDY

Franklin Die Casting Co., Syracuse, N. Y.

Lower Left

T. K. BURNS

Hyatt Roller Bearing Co., Harrison, N. J.

Upper Right

F. H. ELAM

American Steel Foundries, Chicago

Lower Right

J. G. BELDING

Lombard Iron Works & Supply Co., Augusta, Ga.

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

HINTS FOR THE CORE ROOM

(*Continued from Data Sheet No.* 784)

Sandstone deposits are semirock deposits of silica sand cemented together with lime and iron oxide. These sands are much older geologically than any of the previously mentioned sands. Many of these deposits are exceedingly pure and clean and are satisfactory core sands. The cost of mining, crushing, and preparing for the market is rather expensive and makes the cost of this sand prohibitive for extensive use. A typical analysis is as follows:

Chemical Analysis

	Per cent
Silica	95.68
Iron Oxide	1.60
Alumina	1.20
Lime and magnesia	1.17
Volatiles	.35

Screen Analysis

Mesh varies greatly but there is usually a very small amount of fines.

The shape of the individual grains in a sand greatly influences its workability. *Rounded grains* of uniform size give maximum permeability and strength but a minimum of green bond. The sand with varying grain sizes has increased green bond but also requires more binder, more time to properly bake and mix and the permeability (venting property) is greatly reduced. The *elliptically shaped grain* gives more green strength to a sand than the spherical grain, and the permeability is practically the same. *Angular grains* break and pulverize in use much more readily than rounded grains. Such sands are difficult to ram properly; the permeability is generally not good. It has good screen strength but in general is not satisfactory.

Some foundrymen have tried dried sands and it has been found that the moisture in a sand mix is of great importance. Every sand and bond has an optimum moisture percentage. The water added to a mix should be measured as carefully as the bond and sand. This control of the moisture results in further bond economy, more uniform and dependable results. This will bear further investigation by all progressive foundrymen.

Sand Hints

Chemical analysis of any sand is desirable but it is not sufficient to judge all the qualities of a sand. A screen anaylsis, an examination to determine grain shape, and in many cases a refractory test are necessary to handle intelligently a sand. The chemical analysis tells only the constituent elements but nothing as to their mineralogical structure. Many

(*Continued on Data Sheet No.* 786)

HINTS FOR THE CORE ROOM

(*Continued from Data Sheet No.* 785)

minerals have cleavage planes and are brittle while others are tough and hard. Pure silica or quartz is tough and does not fracture readily, but many silicates are brittle and weak. This condition is not shown by a chemical analysis alone. Also calcium and magnesium might be in the form of a silicate rather than carbonate (lime) as is often deduced from the analysis. These properties of a sand only can be determined by microscopic examination and a mineralogical examination along with observations of behavior in actual use.

A simple test to give a rough indication of the amount of fine clay content in a sand is to fill a bottle with a small amount of sand (¼ full), fill with water and shake violently for a couple of minutes and then allow it to settle. The fines will separate in a rather distinct layer on top of the sand and its percentage can be determined roughly by measuring the thickness of the fines and comparing it with the total depth of the sand sample. The clay content will be evidenced by a cloudy liquid after it has stood for some hours; the cloudier the liquid the greater the clay content.

Presence of carbonate (lime) can be detected by dropping a few grains of sand into a bottle filled with dilute sulphuric acid. The carbonate grains will fizz showing clearly which grains contain carbonate. The sand does not have to be removed before making another test and a bottle of acid will serve for tests for a considerable time.

A screen analysis is as important as the chemical analysis. Each different type of work may require a slightly different fineness of sand for the best results. This can be determined by experience and should be adhered to closely. In general core sands are coarser than molding sands. There is also a trend to use only the coarser sands for core purposes. Sands which show from 80 and 90 per cent between 40 and 70 mesh are being used more each year.

Binders

A careful study of the properties, behavior, and proper methods of handling binders is necessary for the best results. Following is a discussion of binders as reported in the literature and as recommended by the manufacturers of the binders.

Oils

Linseed Oil

Specific gravity:—Approx.—0.93 average weight per gallon—7.8 lbs.

Composition:—An oil derived from flax seed and for core purposes is best in the raw state.

Baking conditions:—The recommended baking temperature is from 450 to 500 degrees Fahr. Slow baking is best. The dry bond is developed by the oxidation of the oil at the baking temperature. It is necessary, there-

(*Continued on Data Sheet No.* 789)

Problems in Nonferrous Founding

By Charles Vickers

Brass Gate Is Faulty

We are making some small flat lock castings of an alloy that has to bend; the mixture being 87 per cent copper, 12 per cent zinc, and 1 per cent tin. We experience trouble due to the flat surface after polishing showing scratches, which under magnification are found to be tiny lumps of some hard substance. The scratches do not appear until the castings are buffed with a rag wheel and colored, and then only about 2 per cent of the castings have this defect. We are sending a sketch of the gate which we think may be the cause of our trouble due to the fact the castings may be too near the gate. We pour the molds flat with the face of the castings in the cope, and we put a small piece of phosphorus in the metal. We also send a sample of this casting to illustrate the difficulty, and with it another casting in the rough, which is similar, but can be poured with the same metal, and never show such defects. Possibly you can tell us why we have trouble with one and not the other.

The trouble is caused entirely by the manner in which the patterns are laid out against the gate. The sketch shows that the patterns giving a percentage of poor castings are laid at right angles to the runner, and that the gate from runner to casting juts straight out to connect with the end of the casting. That is a poor way in which to gate a brass casting that must be polished, especially on the sketch it looks as though the sprue was planted right in the middle of the length of the runner, iron snap molder style. So some of the castings get dirt into them on the first dip of the pot in pouring. If the patterns are moved further away from the runner, especially those near the sprue it will be an improvement.

The other casting that comes clean always, does so because it is gated differently. It is a longer casting than the other, being about 1 x 3 inches and rectangular. At either end it bows almost to a knife edge, so the patternmaker had to place the gate on one side near the end, and he has made a small neat gate there. Now if the patterns are arranged at right angles to the runner, the gate has to be curved. If the gate is at right angles to the runner then the patterns have to be laid with one end away from the runner. With either method the metal cannot rush straight into the casting and if there should be dirt get down the sprue it is trapped in the runner and does not enter the casting. We advise the gate be altered to conform as near as possible to the one that gives good castings. This alloy ought to stand 2 per cent lead to make it cut better when the casting is machined.

Q & A

Gives Smooth Surface

We have some bronze castings to make that are required to have a fine and smooth surface as they are used as models from which to cut dies. The pattern is a plaster model, and we have bought castings that were just as smooth as glass.

Use a No. 00 brass sand as a facing, or if the castings are small this fine sand can be used for the entire mold and it will produce a smooth casting. Mold the patterns with the important surface in the cope, and *print back* the patterns. Then skin dry with a torch. This, if carried out with skill will give the glass-like surface desired. To carry out the idea, first, prepare some printing sand. The best that can be obtained is beam dust that is, the dust swept from the overhead beams or ledges in the foundry. Few brass foundries are lacking in beam dust, but if there is none, burn some of the brass sand until it gets red. When cool, put it in a bag such as used for dusting flour on the molds. Make the mold as usual, except that the cope is rammed a little softer than ordinarily. When the cope is lifted off, clean the face of the pattern thoroughly, and if you can get some lycopodium, dust a little of this substance over the pattern.

Spray the cope thoroughly with a fine spray of molasses water, next dust over the cope the prepared sand, using it dry. This dust will take up the dampness produced by the molasses water. No dry dust must be permitted to remain. Now dust over the sand the best parting that can be obtained, and close the cope on the pattern again. Butt-ram the cope carefully all over to imprint the prepared surface against the pattern again. Score the butted surface and add more sand to fill up the cope. The scoring is necessary to form a union with the butted sand, otherwise a parting might be formed and the cope drop out in closing. Lift off the cope and dust slightly with flour from a fine bag. Repeat this until a smooth, white surface is obtained. Just before pouring, torch the mold until toasted, then close and immediately pour, and the result will be a casting that will have all the properties that are desired.

Q & A

Resists Sliding Wear

Please send us a metal mixture that would be suited for trolley gliders. These are to take the place of trolley wheels and must stand a great deal of rubbing on the trolley wire and must also be good in conductivity. The castings weigh about 1½ pounds each.

We suggest the use of the same mixture that has been found good for trolley wheels namely: Copper 92 per cent; tin 6 per cent and zinc 2 per cent; to which is added 1 ounce of phosphor copper per 100 pounds of alloy. The original gliders were simply battered trolley wheels that failed to revolve in the harp so the above mixture ought to give good service. If, however, it is felt that something harder should be used, try copper 88 per cent; tin 10 per cent and zinc 2 per cent. The conductivity of the alloys known as red brass and bronze is low compared to that of copper, and cannot be improved upon to any amount. It is necessary, therefore, to enlarge the section of the bronze so that it will carry the current without heating to any extent.

Makes Special Pulley Castings

Conditions Often Arise in a Shop Where Pulleys Are Required That Would Involve Higher Costs If Short Cuts Were Not Available

BY H. N. TUTTLE

IT OFTEN happens in a shop where the product embraces a large number of pulleys of various sizes, that a special pulley is required of the same dimensions as one for which there is a pattern, except that a wider face is demanded. If the shop has no system of separate rims and spokes, it is, at first thought, a rather disagreeable job to handle. A few methods, that have been employed in a shop of the previously mentioned kind will be described in this article. An ingenious molder can combine or adapt these methods into several other combinations.

Assume that a pulley as shown in Fig. 1 with face *B* is required and that a pattern of face *A*, 1 inch less than *B*, otherwise being of the desired dimensions, is available. This case often happens where the customer wishes to use a wider belt than standard.

One method of using this pattern is shown in Figs. 7 and 8. A core first is rammed up in the half pattern as in Fig. 7. If both pulley halves are exactly alike, two cores may be made from this half pattern. If not, one core should be made from each half. Then, as in Fig. 8, two ½-inch boards, *C* and *D*, are fitted to each half pattern. That is the amount to which the half pattern must be extended. If there is no crown to the pattern, one board, 1-inch thick, would be as satisfactory as the two ½-inch boards.

Cores Are Placed

Plates or standards *E* and *F* are also placed in the pattern and blocked up on the spokes as illustrated. They must extend to within ½ inch of the edge of the pulley rim, or the same dimension as the thickness of one of the center boards. The pattern now is rammed in the usual manner, and after its withdrawal, the cores shown in Fig. 7 are set, resting on surface *F* and held down by surface *E*. These will core out the inside of the pulley, leaving the hub and spokes as in the original pattern. The boards or standards referred to are employed to prevent the sand from filling the pattern beyond the levels indicated. They are removed after they have served their purpose.

A slight modification of this method is shown in Figs. 2, 3 and 4. In Fig. 4, *M* and *N* represent the filler boards, as in Fig. 8. *O* and *P* also correspond to the boards *E* and *F* in Fig. 8, only they are allowed to rest directly on the spokes. The cores made in the half pattern are struck off by the strickle *G* to surface *H*, which is so measured that the distance *HI* in Fig. 2 equals one half of distance *K* in Fig. 4. When the two cores are pasted together as shown in Fig. 3, the total thickness *L* equals the distance *K* in Fig. 4. That distance is equal to the thickness to be added to the pulley face, plus the thickness of the spokes, plus the thickness of the two boards *M* and *N*. After the cores are struck off as shown in Fig. 2, they are bedded in by filling in the remaining space inside the pulley rim with backing sand. Unlike the previous pulley, this one will be increased in the pulley face and likewise an equal amount in the length of the hub.

Lag the Outside

The time honored method in which a piece of belting, *R*, is lagged around the face of the pulley, and wood segments *S* are tacked to it, to make the desired extension, is shown in Fig. 9. Wide wood segments may be substituted for the leather lagging *R*. In either case, this extra stock must be removed from the casting to reduce the pulley to the correct diameter. A somewhat similar method where *T* and *U* show the outside and inside segment cores respectively, is shown in Fig. 10. The space at *V* is the necessary face extension.

Another method sometimes employed is that of punching down the face of the rim with a curved punch stick similar to the section of the rim. This process is not to be recommened, as it invariably leaves a rough and dirty casting. It also is a disagreeable job for the molder. Its only recommendation is that it requires little pattern work. A neater and better way than the latter three plans is illustrated in Figs. 5 and 6. A corebox, shown in Fig. 5, in which the rim portion *XX* is an exact duplication of the top edge of the pulley rim and is ⅜ or ½ inch deeper at the dimension *Z* than the desired extension. This core then is placed on the pulley as shown in Fig. 6. It is held in the correct position by four blocks *YY*, on each half mold. After the mold is rammed and parted, before drawing the pattern, the blocks *YY* are drawn, and their impressions filled with sand.

Special Pattern

If it is quite a common occurrence for special pulleys to be required on small orders where new patterns are required, it is a good plan to have a special board made. The board should be made with pins fitted as shown in Fig. 11 being accurately drilled to fit some standard, template-drilled flask. When a special pulley is required, all that is needed is a half pattern, fastened symmetrically on the centerlines of the previously mentioned board. The half pattern is made easily, as the individual spokes may be tacked directly to the board. They do not require accurate fitting, or strong fastening to the rim, as in the case of a standard hand made pattern. When the pattern is centered properly, as in molding machine work, it only is necessary to make two molds from the half pattern to obtain the casting. Since the board protects the pattern, a number of castings may be made from an otherwise frail and cheap pattern.

A modification of this is to place the half pattern in the exact center of a square corebox and make two cores from it. They must be lined up when they are pasted on the outside edges. This will give a fairly accurate casting if the pattern and core work are done carefully. Obviously, this feature also holds true in the other methods outlined.

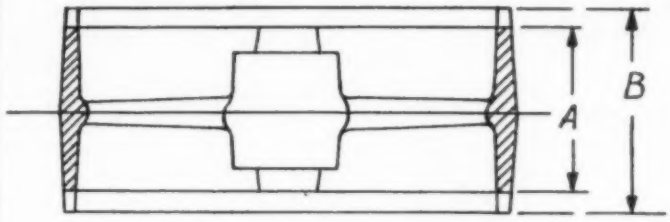


FIG. 1

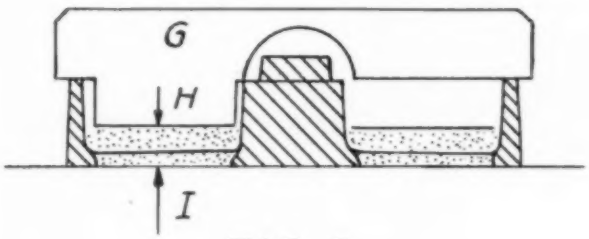


FIG. 2

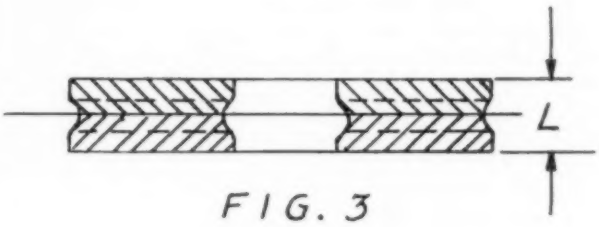


FIG. 3

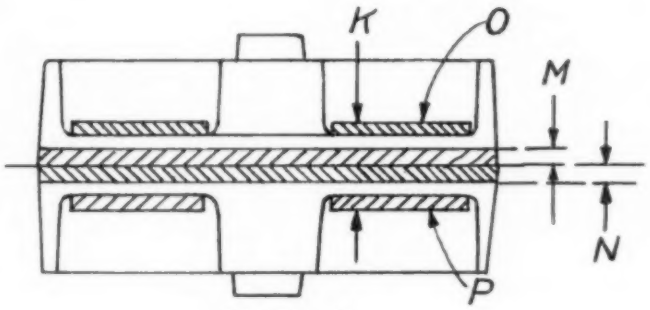


FIG. 4

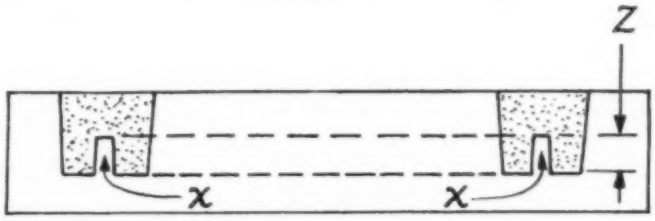


FIG. 5

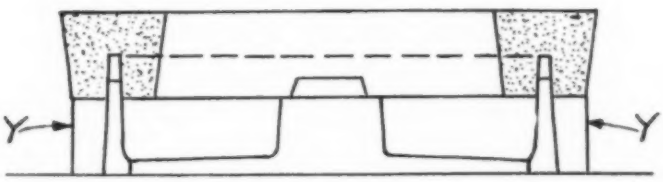


FIG. 6

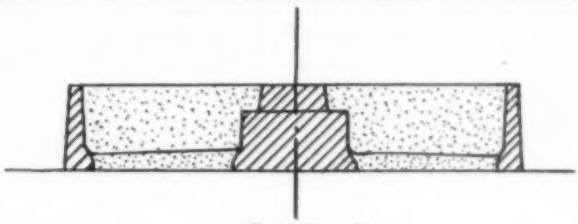


FIG. 7

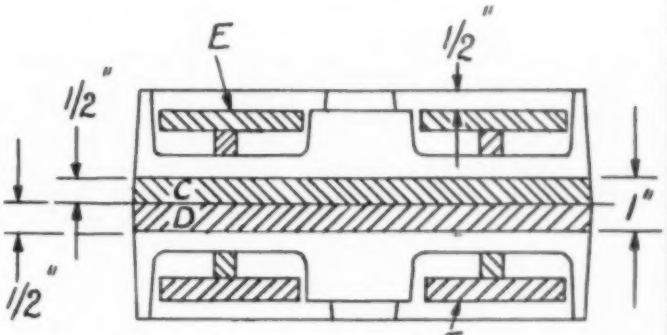


FIG. 8

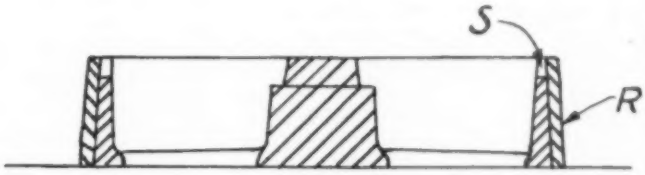


FIG. 9

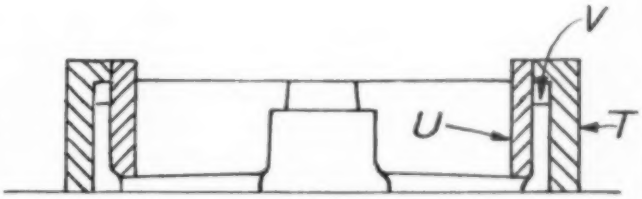


FIG. 10

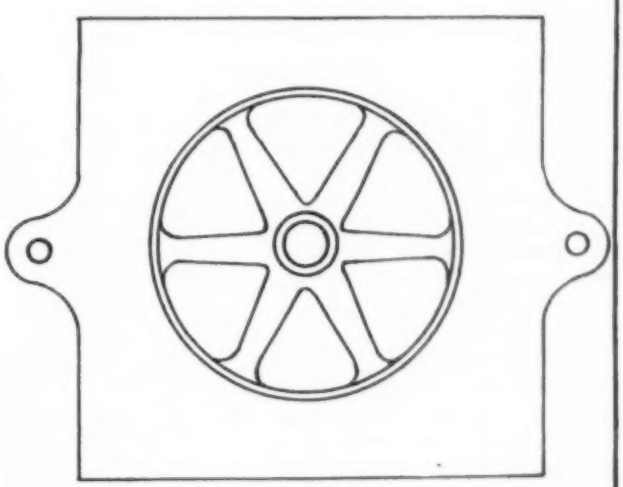


FIG. 11

Some of the Patternmaking and Molding Methods That Are Used in Securing Wider Faces on Pulleys Without Necessitating the Production of New Pattern Equipment

Bill Explains Cause of Cupola Bridge

By Pat Dwyer

IF I had my life to live over again," Bill remarked the other night, "do you know what I would like to do?"

"You mean do I know whom you would like to do?" I inquired suspiciously.

"No," Bill replied, "I ain't like some people I know around here who say one thing and mean another. When I say *what* I mean what and don't you forget it young feller-me-lad. However, now that you mention this *whom* angle to the thing, perhaps you are not so far wrong after all. If I could start all over again with perfect freedom to pick and choose among all the jobs by which men earn a living I would serve my time, or whatever is the proper term, in a dentist's office.

"I would specialize in one branch, pulling teeth. The work is easy and pleasant. The hours are short. The supply of victims is inexhaustible and the remuneration, my boy, is on a greater scale than that enjoyed by the lucky lads who struck the first veins of the gold in the days of '49."

"You talk," I said, "like a prospectus for a dental college. Where did you pick up all these marvelous statistics? I have been into a few dentist's dens at one time or another and I can say truthfully that I enjoyed coming out much more than I enjoyed going in. Furthermore, if I had my choice of visiting every house, workshop and office in this city, a dentist's cute little cubby hole positively is the last place in town I would enter voluntarily. If I was accorded the blessed privilege of entering one of these places with a club, whereby I might knock two or three teeth out of one of the smiling inmates, I don't say but I might revise my opinion. As conditions exist at present, with the balance of power —and then some—in the hands of the executioner, kindly count me out." "You have the wrong slant on this thing," Bill explained. "You are talking from the viewpoint of the man looking in. I am talking, on the contrary, from the much more pleasant viewpoint of the man looking out. I know of no subject which presents such a startling contrast depending on the point of view."

"I know many subjects," I said, "more pleasant to discuss than the pulling of teeth. In fact I often wonder why people are equipped with teeth. They are a source of trouble almost from the time they first make their appearance. During the first few months of a baby's existence, the parents, by working in relays, usually can manage to snatch a few hours rest in the 24. Then the first fiendish tooth begins to work its way upward like the hare brained lad in the song who climbed the mountain of snow and ice, shouting at the top of his voice 'Excelsior!'

"Up to the present no one knows what the baby yells, but that is not because he or she does not yell loud enough, or often enough. The distracted parents run around in circles. They try every conceivable remedy, from patting the howler amidships to swinging it around by the hind legs. They might just as well, by auto suggestion, try to stop a coyote from howling at the moon. However, there is this difference. A man is free to pack a gun and there is no law to prevent him from throwing a stream of lead into the coyote yelper who is making the welkin ring. The game laws maintain a perpetual closed season over infants and that cramps a man's activities with a gun, around the house. The term closed does not mean the infants are closed. They howl in season and out with equal gusto and facility. I think they like to howl.

"Young parents at first, invariably are at a loss to account for the fretfulness of the young calliope. Memory calls up forgotten, disconnected scraps of old wives' tales of misplaced safety pins. A thorough examination of the victim under a strong magnifying glass dispels these suspicions. Finally the doctor is called in. He remarks laconically 'teeth,' pockets his fee and leaves them to fight it out along that line if it takes all summer." "You are not keeping up with the times," Bill interrupted. "Modern parents move at a faster tempo. More *con spirito*, *forte* and *staccato*, Bam! Bam!—if you get what I mean. I heard the other day of a young fella who telephoned a doctor to rush right over as fast as he could. The Doc, with visions of an emergency operation, packed a collection of tools in his bag, crashed through all the red lights on the way, ran up the steps, opened the door and found the lad smoking a cigaret and holding a stop watch in

LOOK OUT! THE DOC WILL GET HIM SOME DAY

one of his tobacco stained paws.

"'What's the trouble?' says the Doc. 'Is the baby—?'

"'Oh! no,' the fella says quite calmly. 'The baby is all right, but this morning my wife wondered how fast you could get over here in the event that darling little precious became ill. To satisfy her I called you up. I suppose you could make a little better time if you really were in a hurry, hey?'

"That's the kind of stuff," Bill continued, "that doctors are up against nowadays. You never hear of any half baked goof pulling that kind of a trick on a dentist. If he did—mind you I don't say he could—but if he did I'll bet you the dentist would back him into the nearest convenient chair and drag out half a dozen of his teeth, preferably those with long, crooked roots, before he left." "Why all this enthusiasm about the dental profession?" I asked. "You have a set of teeth—not quite so numerous, it is true—but quite as solid as those in the face of a crocodile. I don't suppose you ever had a dentist pawing around inside your mouth, jabbing a vent wire in your gums, grinding the fins off with an emery wheel and excavating around the roots with a young pick ax and shovel. If you had any experience of that kind you would be in favor of boiling the whole tribe in oil, or of grilling them slowly over a large open fire of some evil smelling wood, instead of sitting there singing their praises."

"Well," said Bill, "I'll tell you. Man and boy, the old fangs have stood by me nobly until quite recently. I attribute this solely to the sovereign virtues of that toothsome weed, tobacco. I learned to chew—well, not exactly at my mother's knee—she would have belted me soundly if she had caught me at it—I learned to chew tobacco about the same time that I began to harbor what were regarded in those days as heretical views on the subject of Santa Claus.

"Pennies in those days were counted one at a time. One was considered ample recompense for the service of a small boy in periods ranging from 10 minutes to an hour. Times without number I have walked half a mile to the store at the behest of an old maid who lived near us. I have staggered back with a can of kerosene oil in one hand, a codfish wrapped in brown paper grasped by the tail in the other and a loaf of bread under each arm. After depositing the various burdens on the floor and the table, I wiped the sweat from my brow with one grimy paw and tendered the change to the old lady with the other. She adjusted the steel specs and counted the coins one by one. Then she checked over the parcels, mentally added the total cost and counted the change again to satisfy herself that I was not holding out anything on her.

"Many times during this performance I mentally accused her—perhaps unjustly—of purposely stretching the program in the hope that I would leave. She sadly under estimated my powers of endurance. I was right there, like Jack at the rat hole. Finally the great moment arrived. With a toothless smile and the air of a sovereign conferring the order of knighthood on a faithful and valiant subject she said 'and here is a cent for yourself!'

A PENNY WENT A LONG WAY IN THOSE DAYS

"It was not much, but it was 25 per cent of the total amount required to purchase—by proxy—a *fig* of Montreal twist. By diligence, frugality, integrity and practically ceaseless activity, I usually managed to acquire the total amount required each week."

"What has all that to do with the dentist?" I inquired.

"I am coming to that," Bill replied.

"Pray do not hurry," I said. "I can quite sympathize with your beating about the bush tactics. From personal experience I know that a person can invent more excuses for postponing a visit to a dentist's office than he can for avoiding any other place on earth."

"Well," Bill continued, "as I was saying, I learned to chew tobacco while the teeth were sprouting and in that manner protected them from the many insidious menaces which might affect them later in life. You know the old saying, 'Take care of the young fangs and the old snags will take care of themselves.'"

"No," I said. "I never heard that one. You must be thinking of two other fellows from Pittsburgh!"

"Pittsburgh? Who said anything about Pittsburgh? It's a good old town. I was doubled up with a fella in the Mesta there one time whose teeth were worn down to the gums. He claimed this was due to youthful carelessness in leaving his paper of finecut lying around exposed to the atmosphere heavily impregnated with fine particles of iron ore, coke, limestone and other abrasives. When I left, he was contemplating a visit to the Mammoth Cave in Kentucky to study the stalagmites and stalactites. He had an idea the process might be adapted to building a new superstructure on his existing foundation. Unfortunately, I lost touch with him and I never learned the result of the experiment." "He might have tried one of these welding fellows," I suggested, "they think nothing of building tops on worn down gear teeth, so why not on human teeth? The process is much faster than that pursued in the Mammoth Cave and it cannot be any more painful than that practiced in a dentist's howlorium."

"Probably," said Bill, "he never thought of that. He had a kind of a one track mind. Nothing short of a charge of dynamite could lift him from one line of thought to another."

"Apparently," I insinuated gently, "the disease was not catching. At the rate you have been passing signal lights and taking open switches this past half hour, I'll bet you are 40 miles from the main line at the present moment. You don't know whether you started from a dentist's office or a roundhouse."

"You know me kid," Bill grinned. "Old Headlight Bill! One hand on the throttle and one eye on the rail! If you had kept your silly paws off the signal levers, I'd have finished the run long ago.

"Stick your hands in your own

pockets—for a change—shut your mouth and open your ears—also for a change—and I'll tell you about this money making dentist racket.

"On a recent camping trip away beyond hellangone in the North woods, my supply of chewing tobacco ran out a week before we hit civilization. What happened, hey? I'll tell you what happened. I was not back on the job a week until one of my teeth commenced to ache. So far as I could see it was just as solid as any of the others, but it ached to such an extent that I decided to have it taken out.

"On the advice of a friend I went to an imposing building downtown with more dentists and doctors on every floor than there are bees in a beehive. Perhaps I should say wasps in a wasps nest. The wasp is the more workmanlike of the two insects. He seems to throw more life, energy and—shall we say—venom in his sting. Also, he seems to derive more pleasure from the operation. Entering the first office at random I was told by the young lady that her principal did not extract teeth. His specialty was replacing them. She directed me to the office of another lad down the hall who specialized in pulling 'em out. She invited me to return in a couple of weeks when her man would be glad to mortise a new one in the gap. That's team work, my boy!

EARLY BIRDS GOT MARTYR'S CROWNS FOR LESS

"In the second office I was greeted by a young lady in a nurse's uniform. She conducted me into a small room and fixed me in the sacrificial chair. Presently the dentist entered. He is about the size and shape of Longfellow's village blacksmith, with large and sinewy hands—and how! In imagination I could see that bird tying horse shoes in true lover's knots. If he had none handy, he would pull a set off the horse's feet.

"He wasted no time in idle persiflage. 'Which one?' sez he. I pointed to it. He grabbed it with a pair of forceps that made me think of a story I once read of a man whose foot was caught and crushed in a bear trap. He gave one mighty wrench that I was sure split my jaw bone from stem to stern—and the tooth was out.

"'Hah!' he sez. 'Abscessed. You'll feel better now. It did not hurt much did it?'

"Silly question. I could not answer him—mouth full of blood and splinters and so forth—and he knew it. If I could have said a word I would have said, 'Oh! no. Not at all. My jaw feels just as nice as if you had swung—and landed—a 16-pound sledge on it.' Then he ducked into another small room. On the way out I discovered that he had half a dozen of these small rooms radiating from his central office and he had a victim in each one. The little nurse led them in and fixed them up. He followed her, and pulled the teeth out of them. Just like continuous production in a foundry!

"The total elapsed time on each case is about 2 minutes and the fee is $5. Just figure out for yourself the dough that bird pulls—and pulls is right—down in a day. Times certainly have changed. When I was a boy the fee for pulling a tooth was 50 cents and if the dentist expected to make you a new set, he pulled the old ones for nothing.

"That reference some time back to the lad in Pittsburgh who was interested in the stalagmite process reminds me of the trouble some foundrymen have with bridging of the cupola and with burnt or oxidized iron.

"The direct cause of a cupola bridging is the collection of impurities above the melting zone which gradually solidify into a hard shell which prevents the stock from descending. However, while the direct cause is simple, the number of factors leading up to it are many and unless one is familiar with the cupola melting process, some of these factors may appear to be entirely unrelated. Sometimes only one is responsible and at other times two or more factors may be present simultaneously. The principal causes include: Heavy charges, high blast, soft coke, coke that is high in ash, omission of limestone or other flux and uneven charging. Any of the foregoing will cause a cupola to bridge eventually. If more than one is present the bridge will form that much more quickly. The most prolific cause of bridging is failure on the part of the cupola tender to add a sufficient quantity of limestone to each charge to convert the ash from the coke into a liquid slag.

"Heavy charges probably constitutes the second most important cause of cupola bridging. Each heavy charge of iron carries with it a corresponding heavy charge of coke and as a result the incandescent zone fluctuates between a high and a low point with the passing of each charge. At the high point no harm is done, but each time the low point is reached the cold blast comes in contact with the first slag coming trickling through from the succeeding charge and chills it. This process is repeated at every charge and the bridge gradually spreads across the interior of the cupola. Uneven charging will cause a cupola to bridge. This necessarily does not mean that the charges vary in weight. The charges of coke and iron may be correctly proportioned and properly laid out on the charging platform and then all the good work may be negatived by the manner in which the material is thrown into the cupola. Usually, on account of the physical effort involved, the iron is dropped straight down and if it is not level when the entire charge is placed it is higher at the charging door side than it is on the opposite or front side. Coke is lighter than iron and a careless man will not walk back and forth between the charging door and the coke pile any more than he can help. He will stand as far as possible from the door and fork or shovel the coke the remainder of the distance. The coke will pile up against the far wall of the furnace and provide little or no covering for the iron on the near side. As the lop sided charges pass through the melting zone the blast strikes the unprotected iron and any slag in that vicinity will become chilled and the bridge begins to build up.

BELL MAKING
Requires Good Practice

BY W. J. CLARK

ACCORDING to my experience bell metal is comparatively easy on sand. Its straining and burning-in tendencies are mild, due probably in part to its low-pouring temperature, partly from the expansive mold surface inside and out and the comparatively thin wall section of the casting. In the bell mold the metal sets quickly and thereby greatly relieves the mold. A rough sand-burned surface on a bell casting is inexcusable.

However, the bell may swell, either overall or in sections not properly rammed in the mold, especially in the lower mold sections where on account of height of metal the pressure mounts high. Broad, expansive, mold surfaces cut and seal more readily than others, therefore the importance of the best molding practice in a bell mold becomes apparent.

Three Methods Employed

I have molded bells in green sand, in dry sand and by the skin dried method depending on the size and weight. Up to 300 pounds a bell may be ventured safely in green sand properly manipulated. From 300 to 500 pounds the faced and skin dried mold has been found satisfactory. Above that the dry mold enjoys a rational preference.

Temperature of metal and amount of erosion which sand in its different conditions and grades will stand safely, determines in practically all cases whether the casting should be poured in green, skin dried or all dried molds. This in part explains why a foundry making a careful study of the job, the sand and other conditions, can cast metal in green sand while other foundries not making this study often are compelled to use the more expensive skin dried or all dried mold.

For the average bell I prefer sand of medium grain and average bond. If too fine or close, metal unrest develops. Coarse sand leaves a rough casting surface. A finer facing sand covering the pattern surface to a depth of 1-inch backed up by a coarser sand gives a smooth surface.

Sand should be worked on the dry side since in its drier state it tamps more uniformly and to a greater firmness or hardness with safety. It should be uniform throughout and sieved on the floor before using, especially that engaging the pattern surface. To this pattern surface sand, green or dry, I always add flour in the proportion of 1 part flour to 50 parts sand. This causes no metal disturbance and yields an improved casting surface. Pulverized sea coal 1 to 50 in this facing adds further to surface appearance.

Bells ordinarily are molded by one or two methods, crown up as in Fig. 1 or crown down as in Fig. 2. In my experience the crown or hub up position is more efficient and economical. The economical advantage is illustrated in the piece work price on a locomotive bell made by two foundries for the same customer. The foundry molding them hub down paid $1.50 per casting. The one molding hub up paid $1.00.

In the hub down method a two-part flask is sufficient. In the hub up method a three-part flask is required. Molding hub up as in Fig. 1, the drag to cheek parting is at *B*, and the cheek to cope parting is at *C*.

Make the Core

Usually the pattern is set in a follow board and the drag rammed and rolled over. When a follow board is not available the drag is rammed on a level board. The core of the bell is rammed in the bell pattern and the pattern then is placed on the level drag sand surface. In either case the core is rammed mainly by jolt. The sand is butt rammed before it is struck off to a level with the bell pattern edge. The drag sand seat is *scored* and the drag inclined to an angle of 45 degrees to facilitate setting the core and pattern in place.

In Fig. 3, *N* is a dry disk core ½-inch thick used as a ram-up core at the top surface of the green core and is nailed into the green core as indicated. In the majority of cases the metal will kick and cut a green sand surface on account of the steam from the metal rising around the green core. Dotted lines *O* and *P* represent the fine sand facing previously mentioned

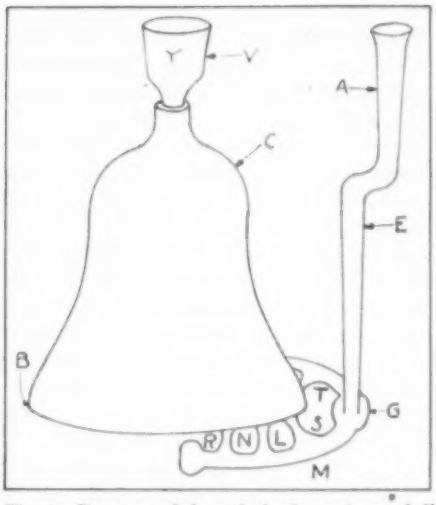


Fig. 1—Recommended method of pouring a bell at the bottom when molded with the crown up

while inner section *H* indicates the coarser grade and more open sand through which ample vents lead down through the drag sand to holes in the bottom board. All sand in the core should be tempered thoroughly and on the dry side.

Use Cleaner Gates

The outside surface of the pattern is faced similarly and firmly rammed. The mold is gated on the bottom as in Fig. 1. The sprue is arranged to break the force of falling metal. The runner gate *M* is of medium size and terminates in the bobs *R* and *R* at either side. Their function is to catch and hold the metal dross and gate sweepings of the first metal poured. The gates *N L S T* etc., are broad and thin and lead into the casting backward from the main line current. The metal filters through them into the mold in a clarified state. The solid hub is fed through riser *Y*. Metal is poured into the mold up to point *V* in the riser. Pouring then is stopped in the pouring sprue *A* and transferred to the riser to furnish it with more live metal for feeding.

The mold surface is well coated with plumbago facing. A brief analysis of the gating method will show that metal drops to *E*, continues to *G*, sweeps dirt and dross from the runner into *R* and filters back cleanly into the mold, thus filling it with remarkably clean metal. The sprue is kept level full throughout the pouring period. No delivering gate is cut at or near the point of fall *G*. This is an important factor in clean delivery of metal to a mold. A gate at this point would produce a dirty casting.

Uniformity of wall thickness is a prime factor in bell making. The flask pins and holes must be true, neat fitting and firm so that no shift possibly can occur. Flask parts should be clamped evenly and firmly during

the ramming period. After the mold is closed it should be clamped in a similar manner. Flask joints should be clean, firm and even in both cases. If the pins are removable, the flask never should be clamped with the pins out. With the cheek closed and the walls carefully gaged, the final clamping of the mold for pouring may strain it out of gaged line by the ordinary clamping method. My practice is to clamp the cheek to the drag from the bottom board up and adjust the clamping to any discrepancies of wall thickness that might develop. Following this I either weight or clamp the cope to the cheek only. Clamping strips are placed firmly on the cheek of the flask, and the clamping done from these strips. I have found this method safe and dependable in three parted molds and others involving several parting surfaces.

Similar practice prevails regarding sand, sand condition, tamping, finishing, etc., in molding hub down as in Fig. 2. Formation of the cope differs radically. An arbor is essential to carry the green sand core. A dry sand core must be suspended from the cope. The hub down method is harder, slower, more exacting and is not nearly as satisfactory as the other method. The only argument favoring it seems to be that any dirt or dross will locate naturally in the inside of the bell, and out of sight of the finished casting.

Loss Is Negligible

By the hub up method I have made many bells absolutely spotless all over after finishing and cannot concede the hub down method any prestige in this respect. Over a period of 3 years I cast probably 150 bells and lost but one in the foundry and none in the machine shop following finishing. The one foundry loss resulted from a mold that remained unpoured from one day to the next. The dry ram up core *N* softened, stripped past the nail heads and lifted. All bell molds since either are poured shortly after they are finished, or, the core is held down by a rod engaging the core through the riser until after the rising metal has covered the core.

The hub up method excels because of its economical advantage, its simpler molding practice, its more proper toning of metal temperature at pouring finish and the better advantage it offers to feed the heavy hub section properly.

In bells cast hub down and where the hub was abnormally heavy I have had to feed the hub with a blind riser and heavy feed gate to defeat shrinkage in it. Gating and pouring from the top in the hub down method

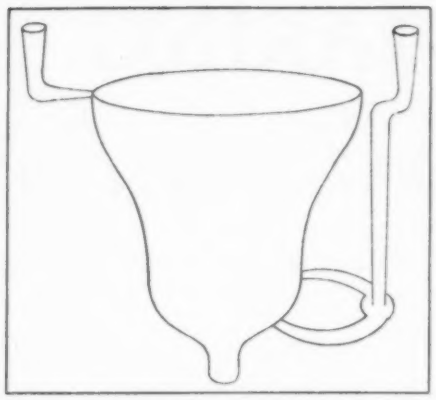


FIG. 2—METHOD OF MOLDING AND POURING A BELL WITH THE CROWN DOWN

would be a logical procedure but from the standpoint of metal action on the mold walls and cleanliness of casting it would be a distinctly bad venture.

Use Torch with Care

The skin dried mold is practically the same as the green mold except that the facing is stronger. The mold face is sprayed with weak molasses water and then dried. Drying a skin dried mold requires skill and patience. It can yield a beautiful casting and it can produce a most ungainly one according to how it is applied. The heat at first must be low, slow and uniformly applied, increasing as the steam becomes less and the sand crust thicker and stronger. Intense heat at the start causes the sand to buckle and crack rendering the mold anything but desirable. For this reason a violent blow torch is risky and the flame must be watched closely. When the skin of a skin dried mold becomes hard and unyielding, it is sufficiently dried and the metal should be poured immediately after.

The all dry mold is the safe and ideal mold for a bell. Castings present a better appearance and more uniformity and symmetry. Molding

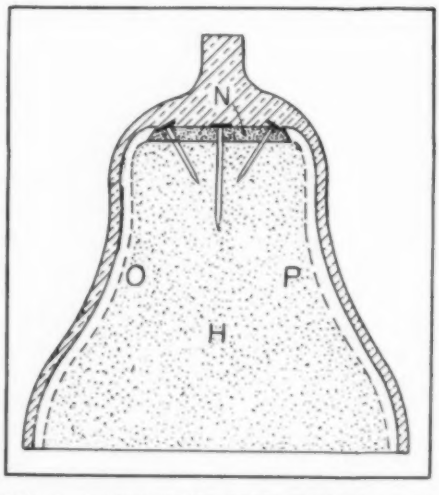


FIG. 3—A DRY SAND CORE IS NAILED TO THE TOP OF THE GREEN SAND CORE

practice is the same as in green or skin dried practice except for the grade and bond of the sand, the wet washing of the mold and the slow and thorough drying of the mold throughout. In the majority of cases it is advisable to use 1 to 2 inches of a fine well prepared bonded facing sand against the pattern, backed by a coarser bonded sand. The finer and better prepared sand should surround all gates and risers.

Nonferrous bell metal is a copper-tin composition with a tin content from 10 per cent up to a practical limit of alloy strength and hardness. The maximum content is at or near 20 per cent tin. Any greater amount of tin results in a metal that is too hard and brittle. The Liberty bell in its original form is said to have contained above 25 per cent tin and is supposed to have fractured from this excessive tin content. Practically all the bells in my experience, have been made from three compositions; Copper-tin 10 to 1, 5 to 1, or 4 to 1. Expressed in percentages this would read: Copper 90, tin 10; copper 83-1/3, tin 16-2/3 and copper 80, tin 20.

Tin Sharpens Tone

Advancing tin content increases hardness and brittleness in the alloy and amplifies clearness and sharpness of tone. Comparatively speaking a bell of 90 copper, 10 tin sounds dull, of 83-1/3 copper 16-2/3 tin sharper and clearer, of 80 copper, 20 tin distinctively more so. A bell of the common bronze alloy: Copper 85, tin 5, lead 5, zinc 5 has nothing of distinctness in its ring while one of pure copper or of copper zinc, or copper zinc-lead is practically dumb. The *ring* of any copper alloy is at least a rough indication of its tin content and often is used to judge the approximate tin content.

The straight copper-tin composition has little if indeed any protection from the evils of melting and manipulating temperatures, evils such as oxidation, gasification etc. For this reason a slight addition of zinc, ½ to 1 per cent, frequently is included. A trace of phosphorus nearly always is added either with or without the zinc which volatilizes and practically disappears.

A bell of copper 88, tin 10, zinc 2, has a respectable *ring* and sometimes is used for ordinary bells. To the regular copper-tin bell alloy antimony from ½ to 2 per cent sometimes is added and makes a slightly harder alloy.

Good bell metal demands most careful and exact practice in its melting and pouring. Constitutionally low of re-

agent constituency it is naturally susceptible to and expressive of the gasified and oxidized metal condition. Such metal is absolutely unfit for any bell of quality. Only clean, solid, compact metal will give clear, distinct, sharp tone or insure the necessary metal strength in a bell.

Bells of the same shape and size made from the same alloy in the same foundry frequently *ring* differently due to the metal condition in them. The effect of impaired metal in a bell, either in section or throughout, is to deaden the tone and weaken the mechanical resistance of the metal.

The grade of metal used is another prime factor of bell quality. Cheap, inferior brands of virgin metal never give satisfactory results. Scrap metal in which the composition is unknown is still more unsatisfactory. Best lake or electrolytic copper, and Straits or Banca tin, measures up to bell metal standards.

In making up the charge, the proportions of new to scrap metal, gates, risers, etc., must be established judiciously. Good metal may be had on a 50 new 50 old basis. On a 60 new 40 old basis the quality naturally improves while on a 40 new 60 old it drops though to no serious degree. Below the 40 new 60 old basis the metal at least is questionable for exacting castings.

Explains Melting Practice

In melting the metal, the scrap and virgin copper are reduced first. The tin and zinc are added about 5 minutes before drawing the pot from the furnace and stirred thoroughly with a carbon stirring rod or an iron rod painted with fire-clay wash. The melting is done throughout under charcoal and the most satisfactory metal seems to come from the crucible furnaces that are either coke, gas or oil fired.

Pouring temperature should be held low. Bells poured hot are not nearly so clean and solid as those poured rather on the cold side. This does not mean metal in a dull sluggish state but rather at a rational low instead of an irrational high heat. Metal in the furnace never should be heated much above its proper pouring temperature nor held long in the furnace.

Proper temperature varies with the size, shape and section of the bell. Bells of heavy wall or those of less expansive surface naturally require colder metal than those of light wall and expansive surface. The practical man judges the pouring temperature by the color, the brightness and the prominence of the rainbow like colors of the tin content which exhibit outstandingly on the metal surface when hot but fade to mere suggestions as the temperature drops.

When the metal is dull red, practically void of dazzling brightness, rolls lazily under the skimmer pushed across its surface and exhibits only a subdued suggestion of the purplish yellow tin tints then for the average purpose I consider it near its proper pouring temperature for bell castings.

British Institute Meets in Germany

THE autumn meeting of the British Institute of Metals was held in Duesseldorf from Sept. 9 to 12 at the invitation of the Verein Deutscher Ingenieure and the Deutsche Gesellschaft fuer Metallkunde. About 300 members and their ladies registered at Duesseldorf, fifteen countries being represented. The local reception committee arranged a most interesting program. Dr. Ing. Max Haas, honorary local secretary, rendered invaluable assistance in making the necessary arrangements for the meeting.

Visit Foundry Exhibition

During the afternoon of Monday, Sept. 9, the members visited the German Foundry Trade exhibition, at which a large amount of space was devoted to educational and technical exhibits. Later in the afternoon the annual autumn lecture on "Aluminum and Its Alloys" was delivered in German by Dr. A. G. C. Gwyer.

Fourteen papers were submitted, but only a portion of these were read and discussed at the meeting. Technical sessions were held in the mornings of Sept. 10 and 11. At the first one the institute was welcomed to Germany, and to Duesseldorf in particular, by R. Keith Jopson, acting British counsul at Cologne, and Professor Bauer. The president, Dr. Walter Rosenhain, then conferred the honorary membership of the institute on Professor Tammann, director of the Institute of Physical Research, Gottingen.

Two important papers on methods of research in England and Germany respectively were: "Some Methods of Research in Physical Metallurgy," by Dr. Walter Rosenhain, president, and "Methods of Research in Metallography," by Dr. G. Masing, Germany. The first described some of the methods which have been used and developed at the National Physical laboratory for the study of metals, especially in connection with the determination of equilibrium diagrams. One apparatus of particular interest was a novel form of electrical dilatometer which makes use of the change in the capacity of a condenser which is varied by the dilatation of the specimen. Dr. Masing's paper dealt more with the fundamental principles underlying the methods used in the study of the constitution of alloys, and which must be based on the well-established thermodynamical laws of equilibria. The limitations of these methods were discussed.

Thermal Method Is Important

In the discussion that followed, Professor Hanson, Birmingham, emphasized the importance of the thermal method of determining the constitution of alloy systems, particularly at high temperatures, and was of the opinion that this was the most satisfactory method at present available for the study of alloys during solidification. Sir Henry Fowler, London, Midland & Scottish Railway Co., Derby, stressed the importance of these two papers, and added that engineers fully recognized that if they are to have the special alloys which modern engineering practice calls for, fundamental work of this character is absolutely necessary. Professor Thompson, Manchester, referred to the development of special refractory materials which he considered to be one of the most important factors in work of this kind.

Speaks on Aluminum Alloys

The paper on "A Dilatometric Study of Some Uni-Variant Two-Phase Reactions," by Chevenard, Portevin and Wache, dealt with the reactions taking place in quenched aluminum-copper and aluminum-silicon alloys annealed at various temperatures, and also with certain phases of the alloys of iron, nickel and copper. Dr. Max Haas and Dr. Denzo Uno presented a paper on "An Improved Differential-Dilatometer." In the discussion, Dr. Marie Guyler, National Physical laboratory, reported that certain of the results disclosed by Chevenard had been confirmed by other methods. Professor T. Turner, in congratulating the authors, briefly reviewed the advances that have been made in dilatometry during 50 years.

A paper by M. Tama on "Progress in Electric Furnaces for Nonferrous Metals" evoked a lengthy discussion. Dr. Brownsdon, speaking of high-frequency induction furnaces in particular, said that linings still constitute a difficult problem, which he believed could be made easier if the furnaces were of a more simple shape. He also was of the opinion that small high-frequency units are not always advantageous.

Dr. R. S. Hutton said that electric annealing results in a better quality finished material. D. F. Campbell. said that the size of the melting furnace should be determined by the size of the ingots being cast, and that in no case should the total casting time exceed 10 minutes. Large high-frequency induction furnaces, while in some cases being desirable, are difficult to construct, and he mentioned the case of a large furnace in France that had been used as a mixer with bath analyses, as suggested by Dr. Brownsdon, but which now has been abandoned in favor of smaller furnaces, which he himself preferred.

R. S. Archer, Aluminum Co. of America, Cleveland, did not agree with complete conversion to electric furnaces. He said that in the aluminum industry in the United States, whereas electric furnaces are used for the heat-treatment of castings, a fused nitrate bath is preferred for sheet metal. A. J. G. Smout gave the result of using electric furnaces in Birmingham, and said that for melting the fuel bill is doubled, but labor costs are halved and the net result is a better product. Also, for the high-quality finish required at the present day electric annealing is essential. In his reply, Mr. Tama did not agree with Dr. Brownsdon on the question of linings, and said that he is getting as many as 2000 heats from his linings, which may be considered satisfactory.

During the afternoons of Sept. 10 and 11 parties of members visited the following works near Duesseldorf: J. G. Schwietzker, nonferrous foundry; A. Schmitz, rolling mill works; August Thyssen-Hutte, steelworks; Demag, A. G., makers of mining and metallurgical machinery; Berg-Heckmann-Selve, A. G., Zweiginederlassung; C. Heckmann, copper works; The Kaiser Wilhelm Institute for Iron Research.

On Sept. 12 there was an all-day excursion to Krupp's, at Essen, where members were shown the new blast furnaces, steel smelting shop, rolling mills, hydraulic forging presses, including the new 10,000-ton forging press, foundries and finishing shops, while the ladies visited the 1929 Flower and Garden exhibition at Essen. Members and their ladies were guests of Friedrich Krupp, A. G., and visited the research laboratories.

Supplies Firm's Needs

(*Concluded from Page* 868)

flask to be filled with sand. This operation then is completed and the sand rammed in place. The mold is then struck off, lightly sprinkled with sand and a smooth bottom board rubbed into place.

The three part mold is then rolled over in the position it will occupy when poured. The cope is removed and set aside. The rib section forming the top of the casting is removed and placed on the bench. Then the cheek is lifted off and set aside. This leaves the drag and the lower half of the skeleton pattern which is removed and set aside. The three parts of the mold are inspected and any small defects patched. Cutting the runner gates in the cope also is done at this time. As may be seen in Fig. 4, the sprue for the gate is placed in about the center of one side with a runner gate almost ending in a sprue for the riser. Thin flat gates lead to the four corners of the cavity as well as midway between the corners. After finishing, the three parts of the mold are placed in their proper positions, the mold weighted and poured.

Fig. 3 shows three castings made in bronze. The casting at the left is a flat disk about ½-inch thick with a hollow hub at the center and a number of radially arranged fins about ¼-inch thick on the top. As may be seen from the illustration, the casting is gated from a runner half-encircling the outside edge. Four flat branch gates conduct metal from the runner to the casting. The four castings on the common runner shown at the right presented some difficulty at first due to leakage. The castings must withstand high pressure and possess a smooth surface inside and out. After some experimenting the difficulties were overcome by using the double, flat branch gates shown.

The casting shown in the center is a thin hollow form and was cast face down, with the green sand core formed hung in the cope. The sprue for the gate was placed near the upper right hand corner of the casting in the position shown in the illustration. A runner gate from the sprue followed the outline of the cavity to approximately the point where the champfer begins at the upper left. Five flat gates, equally spaced, on each side fed metal to the casting.

Research Activities Are Moved to New Jersey

General Naval Stores Co. Inc., North Side National Bank building, 4125 Hamilton avenue, Cincinnati, has moved its research laboratory from Cincinnati to Passaic, N. J., where it will occupy quarters on the premises of the Newport Chemical Works. E. V. Romaine, technical director, research division, and H. J. Warmuth, chemist, have been transferred to the new location where they will continue in charge of the research facilities of the company.

Company Expands Plant and Office Facilities

Osborn Mfg. Co., 5401 Hamilton avenue, Cleveland, has placed a contract with the Hunkin-Conkey Construction Co., for a new factory and office building to adjoin the present plant. The addition will increase the manufacturing and office space 25 per cent. The three lower floors will be used for manufacturing and the top floor will provide additional space for general offices. Both the brush and the machine division of the company will benefit by the expansion program. Construction of the new addition will begin at once, according to Franklin G. Smith, president of the company.

Moves Plant Activities

Domestic Electric Co., Cleveland, a subsidiary of Black & Decker Mfg. Co., Towson, Md., has purchased a group of buildings and a tract of land at Kent, O., which will be devoted to the production of fractional horsepower motors. The new buildings contain approximately 140,000 square feet of floor space and are adjacent to the tracks of the Pennsylvania, Baltimore & Ohio, Pittsburgh & Lake Erie and the Erie railroads. The manufacturing facilities of the Cleveland plant will be moved to the new location soon.

Re-elects Officers

Electric furnace section of the National Electrical Manufacturing association, 420 Lexington avenue, New York, recently held a meeting at which W. D. Little and R. F. Benzinger were re-elected chairman and secretary, respectively. Both men are executive members of the association. The former is connected with the Hoskins Mfg. Co., Detroit, and the latter with the Electric Furnace Co., Salem, O.

WHAT OTHERS ARE THINKING

Abstracts Selected from the World's Foundry Literature

Injects Water Into Cupola

Der Kupolofen mit Wassereinspritzung, by Works-director Harr, *Die Giesserei*, June 21, 1929.

This article describes a process developed by the Vulkan-Feuerung A.-G., Cologne, Germany, in which water is injected into the tuyeres of a cupola or other furnace to intensify combustion and increase the temperature in the melting or combustion zone. The device used consists essentially of a filter to remove solids from the water supply, water measuring apparatus for each tuyere, and nozzles for the same. The water is filtered through small duplicate filters containing glass wool on sieves. Then it passes through regulating valves into glass measuring tubes which appear to employ the venturi principle. Each tuyere has a measuring tube of its own and these are mounted together on a stand with a protecting case. Small tubes conduct the water to the tuyeres where it is injected into the cupola through nozzles which give a whirling action. The nozzles do not quite reach the inner edge of the tuyeres and thus are said to be protected from iron, slag and burning off. Advantages claimed for this process are: Increase of temperature in the melting zone; saving in coke or more material superheating of iron and slag; diminution of loss; decrease in sulphur pickup; acceleration of melting speed with the same quantity of air; saving of furnace lining, and saving in costs. With the correct amount of water and application of the principle of water injection, the temperature in the melting zone is increased 50 or 60 degrees Cent., and the rate of combustion is increased. The heat balance of the cupola is improved and about 15 per cent coke is saved with the iron being hotter than without the process. Decreased coke consumption means less limestone and thereby slag. Also the sulphur pickup should be less A more favorable composition of the slag obtained decreases the slagging off of iron, manganese and silicon.

Discusses Practical Bronze Founding

Practical Points from the Metallurgy of Cast Bronzes, by H. C. Dews, *Foundry Trade Journal*, London, June 20, 1929.

Porosity in bronze castings is due to freezing over a range of temperature and contraction during freezing. These two features account for the majority of the troubles encountered in bronze founding. Contraction cavities will not form if liquid metal is continually available to flow up to the solidifying dendrites. To insure that each section of a casting as it freezes, shall be in communication with liquid metal either from a thicker section, from a section filled later or from a riser is a difficult art. The paths must be short, the metal sufficiently fluid, and there must be no mechanical obstructions to impede easy flow. An alloy with a 5 per cent tin content begins to freeze at 1050 degrees Cent. and a 10 per cent tin alloy starts to freeze at 1000 degrees Cent. When cast in medium-size sand castings the 5 per cent alloy finishes freezing at 875 degrees Cent. while the 10 per cent alloy finishes at 800 degrees Cent. Addition of 1 per cent phosphorus to a 10 per cent tin alloy reduces the initial freezing point to 950 degrees Cent., and the final solidfication point to 630 degrees Cent. Zinc affects the freezing range by lowering the initial freezing point. A rough idea of the effect may be computed by assuming that each 2 per cent zinc has the same effect as 1 per cent tin. Thus, an alloy containing 8 per cent tin and 4 per cent zinc would have a freezing range similar to a 10 per cent tin alloy. A good, strong bronze is shown by a fracture which is uniform in color and has a silky appearance. Weak porous metal is indicated by red and brown patches. Oxidized metal is indicated by widespread discoloration not to be mistaken for porous spots which are local discolorations. Zinc and tin oxides are insoluble in bronze. Zinc oxide is light and rises and may be removed by skimming carefully. Tin oxide is nearly as heavy as the metal and may remain disseminated in the metal as fine insoluble particles.

Compare Types Of Malleable

Malleable Cast Iron, by M. Godefroid. *La Revue de Fonderie Moderne*, Paris, June 25, 1929.

In this article, malleable cast iron is divided into three categories: White heart, or Reaumur malleable; black heart, or American malleable; and the third is an intermediate between the other two. White heart malleable iron has a tensile strength of from 56,890 to 64,000 pounds per square inch and a maximum elongation of 5 per cent; black heart malleable has a tensile strength of from about 46,935 to 64,000 pounds and an elongation of from 12 to 20 per cent; the intermediate malleable has a tensile strength of about 56,870 pounds and an elongation from 6 to 10 per cent.

After discussing the equilibrium diagram, the article describes the production of malleable iron. The primary iron is different in the case of white heart or black heart malleable, and average compositions are given for both cases. In discussing the method of obtaining white heart malleable in the cupola it is pointed out that black heart malleable also can be obtained. The use of reverberatory furnaces, electric furnaces and of various combinations then is explained briefly.

In dealing with annealing, the author states that in the French method a high temperature ranging from 950 to 1000 degrees Cent. is used; the duration of heating is longer than for American malleable. A comparison between white heart and black heart malleable is given. It is shown that white heart is materially easier to obtain. On the other hand, American malleable has a more uniform structure for thick and heavy castings, which increases its interest for industrial purposes. Results of tests made on white heart and black heart malleable iron are shown. The effects of sulphur and manganese, chromium and silicon, nickel and copper, carbon and silicon, on the annealing are given.

Figures Time for Pouring

"Pouring Phenomena," by M. Lamoureux. *Bulletin of the Association Technique de Fonderie of Belgium*, September, 1929.

The author recalls that 18 years ago he recommended giving a larger section to the gate at the point where the metal actually fills the mold. He demonstrates this theory by a Mariott flask. First it is shown that if a gate with a small section is used, primarily with the object of preventing scum from entering the mold, the action of the metal in meeting the walls and the cores is too strong and deteriorates both the cores and the walls of the mold. If, on the other hand, the section of the gate at the outlet is of a larger diameter than at the pouring end, the metal enters the mold quietly. It is pointed out, however, that the diameter should not increase in the downward portion of the gate, as this results in air being taken into the mold. On the other hand, when bottom pouring is used the most tranquil effect is obtained by increasing the diameter in the upward portion of the gate. The same method of procedure is used to show the effect of the American method of pouring in zigzag with risers at each angle. It is shown that the mold is filled more quickly when there are risers than when the mold is completely closed.

With regard to the section of the gates, it is claimed that the cylindrical section is always the best. With regard to the speed of pouring, two castings of the same thickness and height can always be poured in the same time, whatever their diameter. The author gives the following formula for the time of pouring:

$$T = 5 + \frac{E \times H}{2500}$$

in which T is the time of pouring in seconds, E the thickness of the casting in millimeters, H the height of the casting in millimeters, the first figure 5 being the average number of seconds required to bring the ladle to its proper position and to raise it up again. Denominator is a constant.

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¶ Industry Suffers Loss

IN THE death of H. Cole Estep, reported on another page of this issue, the entire foundry world has suffered a distinct loss. Although educated as an engineer and employed continuously in editorial and publishing work since leaving college, the force of his splendid intellect was applied to bettering business and industrial conditions in the foundry industry. His vision, initiative, energy, persistence and ability were brought to bear on the problems which confront foundrymen. The charm of his personality assisted qualities of leadership which permitted him to accomplish so much in the work of his choice.

AS ACTIVE member, chairman of the papers committee and finally director of the American Foundrymen's association, Mr. Estep furthered technical education. Through THE FOUNDRY, he aided in collecting and disseminating knowledge of foundry practice. These activities evidence his service to the industry, but his greatest actual accomplishment will be found in the impetus he gave to international co-operation of foundrymen. He furthered the exchange of papers between American and overseas foundry societies. As chairman of the American Foundrymen's association committee on international relations he helped inaugurate and continue the international congresses of foundrymen. The immediate result has been the spread of knowledge. The more far reaching effect in the promotion of international peace through better acquaintance and understanding among foundrymen throughout the world, will be appreciated by generations yet to come.

¶ Castings and Machine Tools

ONE point that impressed all visitors at the National Machine Tool Builders exposition, held Sept. 30 to Oct. 4, in Cleveland under the auspices of the National Machine Tool Builders association, was the large number of castings used in the construction of practically all equipment displayed. It is certain that foundrymen will be called upon more than ever to supply parts for production machines as they become more and more useful in industry. With the development of new tools for high cutting speed and increased stresses on the machines required to do the work, the demand for castings in that field will increase. From observations at the displays, the foundryman has little to fear in this field from other materials.

ANOTHER point observed was that many of the machines were designed specifically for machining castings. Many machines including turret lathes, both of the horizontal and vertical types, grinding machines of all kinds, milling machines and other tools used castings in their demonstrations. This shows that the machine tool builders are dependent upon the foundries not only for the materials from which they build their machines but in a large measure for the field for their product.

¶ Should Meet and Mingle

A CONTRACTOR or manufacturer requires some castings. He buys them according to known specifications and perhaps some engineer on the job suggests a new form of test differing from those previously provided. The castings fail to meet the new requirements. The buyer blimblams the foundryman and he in turn the engineer. Who is at fault? Perhaps the engineer for running in a new set of test conditions. He probably knows castings only in a superficial way and has inherited a doubting disrespect for all cast metals. Accordingly, if they fail to meet the new tests whether these be based on machining, hydrostatic pressure, or X-ray examination the engineer feels his previous judgment vindicated.

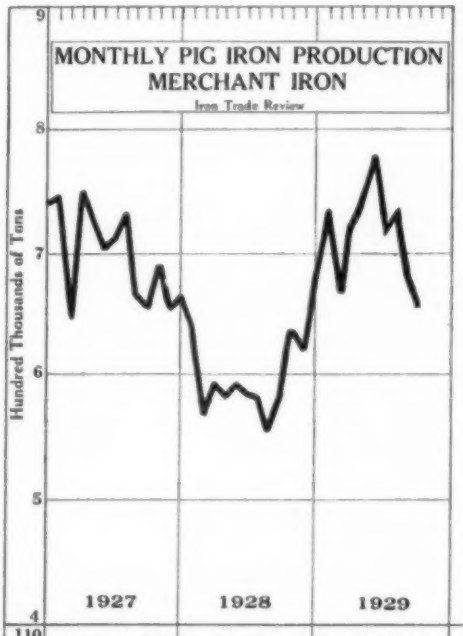
FOUNDRYMEN, too, are at fault. How often do they as individuals or through their local or national organizations take the trouble to educate the profession whose members sit as the court of last resort—the engineers? The first steps have been taken to give to engineers and designers a sounder knowledge and appreciation of the merits of cast metals. In this work the local foundrymen's associations can be of service. Arrange joint meetings with groups of local engineers. Meet them and know them, let them hear good speakers on chosen subjects. Engineers know and understand other materials of construction, such as steels, and concrete, for from their earliest attempts to learn engineering, they have been permitted to "touch, taste and handle" them. Sell castings to *them*.

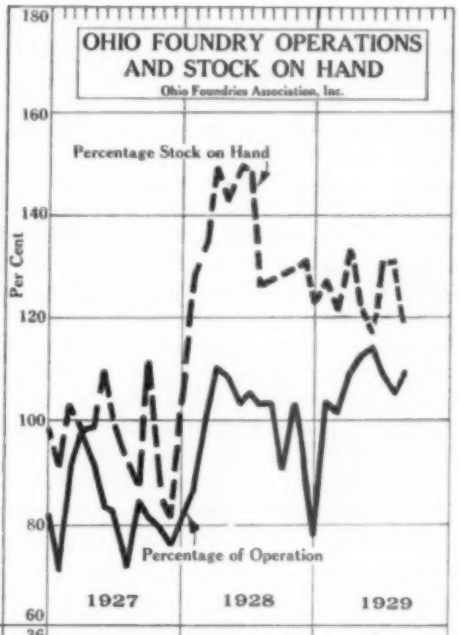
Trade Trends in Tabloid

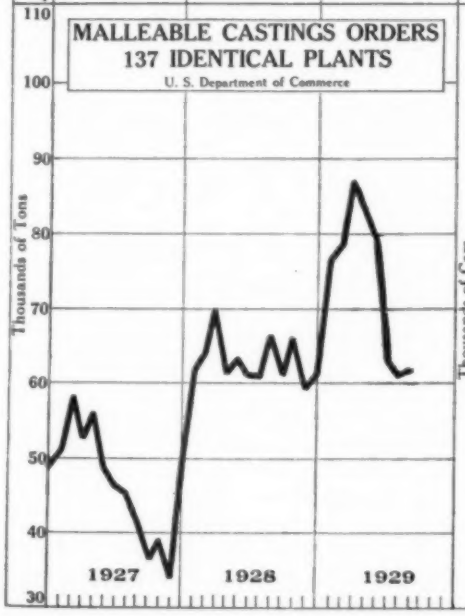
ONE conspicuous bright spot in the expectation of future castings orders is from railway sources. September car orders totaled 2584 units and inquiries were extant for more than 10,000 cars, according to estimates. The National Machine Tool Builders show held during the first week in October indicated by both interest and sales an increasing demand from this class of castings purchasers. Gray iron jobbing foundries in the east are operating at from 70 to 75 per cent of normal. Malleable orders are slightly stronger than during the fore part of September. Cast-iron pipe sales, particularly in larger sizes, are advancing. Orders for sanitary ware and radiators are steady with production practically balancing sales. Unfilled orders for locomotives have ranged from 350 to 500 units during the past six months compared with from 100 to 150 during the entire year in 1928. The total production of pig iron according to statistics in *Iron Trade Review* was 3,482,936 long tons in September compared with 3,746,936 in August. Merchant iron output totaled 660,178 in September against 682,048 during August. Average daily price in September of nonferrous metals, according to New York quotations in *Daily Metal Trade* follow: Casting copper, 17.771c; electrolytic copper, 18.00c; Straits-tin, 45.382c; lead, 6.886c; antimony, 8.675c; aluminum, 23.90c. Zinc averaged 6.800c, E. St. Louis, Ill.

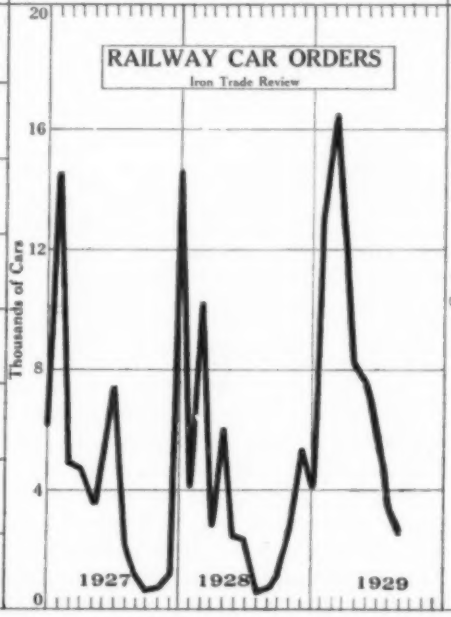
RAW MATERIAL PRICES
Oct. 9, 1929

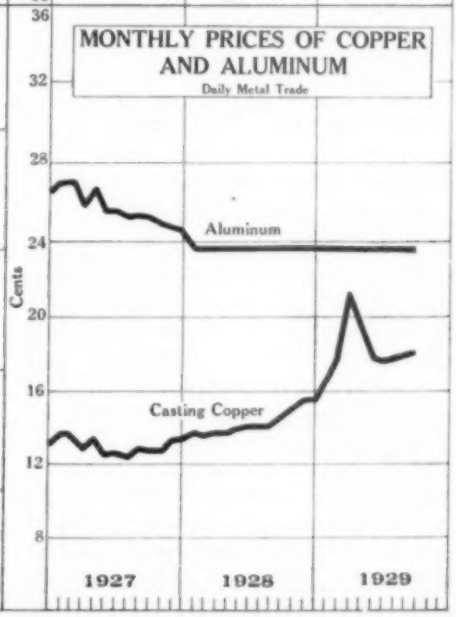
Iron	
No. 2 foundry, Valley	$18.50
No. 2 southern, Birmingham	14.50
No. 2, foundry, Chicago	20.00
No. 2 foundry, Philadelphia	21.76
No. 2 foundry, Buffalo	19.50
Basic, Valley	18.50
Basic, Buffalo	18.50
Malleable, Chicago	20.00
Malleable, Buffalo	20.00
Coke	
Connellsville beehive coke	$3.75 to 4.85
Wise county beehive coke	4.25 to 5.00
Detroit by-product coke	8.50 to 9.00
Scrap	
Heavy melting steel, Valley	$17.25 to 17.75
Heavy melting steel, Pitts.	17.50 to 18.00
Heavy melting steel, Chicago	14.50 to 15.00
Stove plate, Buffalo	12.50 to 13.00
Stove plate, Chicago	11.00 to 11.50
No. 1 cast, New York	12.50 to 13.00
No. 1 cast, Chicago	14.00 to 14.50
No. 1 cast, Philadelphia	16.00
No. 1 cast, Pittsburgh	15.00 to 16.00
No. 1 cast, Birmingham	14.00 to 15.50
Car wheels, iron, Pittsburgh	15.50 to 16.00
Car wheels, iron, Chicago	14.00 to 14.50
Railroad malleable, Chicago	17.00 to 17.50
Malleable, Buffalo	17.50 to 18.00
Nonferrous Metals	**Cents per pound**
Casting, copper, refinery	17.62½
Electro, copper, producers	18.12½
Straits tin	43.37½
Lead, New York	6.90
Antimony, New York	8.37½
Nickel, electro	35.00
Aluminum, No. 12, producers	23.00
Aluminum, No. 12, remelt	17.00 to 17.50
Zinc, East St. Louis, Ill.	6.80











Comings and Goings of Foundrymen

Men of the Industry, Whose Activities Are Making Foundry History

JOHN DUFFY has become connected with the Troy Sunshade Co., Troy, O., as foundry superintendent. Mr. Duffy was educated at Rutherford college, Newcastle-on-Tyne, England specializing in iron and steel manufacture. He received his foundry training under his father at Messrs. John Spencer & Sons, Newburn-on-Tyne. After working some years as journeyman molder in various shops in England, he was given charge of the molders at the Electro Flex Co., Dunston-on-Tyne. Coming to America after the war, Mr. Duffy first was connected with the Bliss Co., Brooklyn, N. Y., and later with the Newport News Shipbuilding & Dry Dock Co., Newport News, Va., as foreman molder. He resigned the latter position to become foundry engineer with Fairbanks Co., Binghamton, N. Y., in charge of both their iron and brass foundries. He next was associated with the Worthington Pump & Machinery Corp., Harrison, N. J., as foundry superintendent in charge of the nonferrous foundry. Following the Philadelphia convention of the American Foundrymen's association, he went to Milwaukee, as metallurgist to the American Metal Products Co. While there he made some interesting experiments in the production of a high test iron using molybdenum as the alloying element.

J. C. Taylor Jr. has been appointed vice president of the Taylor-Wharton Iron & Steel Co., High Bridge, N. J., in charge of sales.

Alfred Carter, for the past 5 years assistant foundry superintendent for Gould Pumps, Inc., Seneca Falls, N. Y., has resigned to accept a position as foundry foreman with the Cooper Bessemer Corp., Grove City, Pa.

Maurice E. Brown, formerly foreman with the Union Malleable Iron Co., East Moline, Ill., has resigned to join the sales force of the Arcade Mfg. Co., Freeport, Ill.

Peter Worthy, Jr. has been appointed superintendent of the Fort Pitt Steel Casting Co., McKeesport, Pa., to succeed H. F. Stratton, resigned. Mr. Worthy became identified with the company in 1913 as assistant in the production department. He was promoted to be chief of that department and then assistant to the superintendent. In 1926 he was transferred to the sales department and on Sept. 15 returned to the operating department as superintendent.

D. G. Anderson, chief of the foundry development department, Hawthorne works, Western Electric Co., Chicago, recently was elected chairman of the board of directors of the Chicago Foundrymen's club.

James M. Sampson, superintendent of the foundries and pattern shop of the General Electric Co., Schenectady, N. Y., sailed for Europe Oct. 2 to visit foundries on the Continent and the British Isles.

H. J. Young, engineering chemist and metallurgist, well known in foundry industry for his researches on cast iron and Y. A. Calderwood, an engineer of wide experience in Great Britain, France, Belgium and Russia, have formed Calderwood Young & Co. The firm will act as merchants, agents, representatives, importers and exporters. Registered offices of the company are at 3, Central buildings, Westminster, London, S.W.1.

G. H. Waters has resigned as vice president of the New York Air Brake Co. to become president of the Marion Steam Shovel Co., Marion, O., effective Oct. 1. He succeeds J. L. Ackerson, resigned. J. H. Waters, Mathew C. Brush and M. J. O'Brien have been elected directors of the Marion company to fill vacancies caused by the resignation of J. L. Ackerson, W. F. Hoyt and F. S. Connott.

C. F. Scherer, superintendent of the Davenport Machine & Foundry Co., Davenport, Ia., was elected chairman of the Tri-City Technical council at a meeting held Sept. 20 at the LeClaire hotel, Moline, Ill. Howard Rogers, assistant treasurer, Williams, White & Co., Moline, Ill., was elected vice-chairman; E. C. Xander, assistant secretary, Tri-City Manufacturers' association, Moline, Ill., is the new secretary and Max Sklovsky, Deere & Co., Moline, Ill., continues as treasurer.

R. R. Stevenson, general superintendent of New Kensington, Arnold and Logans Ferry works of the United States Aluminum Co., has been transferred to Pittsburgh as assistant to Col. R. L. Streeter, vice president. He will be succeeded by Ralph M. Ferry, general superintendent of the Edgewater, N. J., plant. W. C. Winter, assistant superintendent of the New Kensington plant ,will succeed Mr. Ferry. H. H. Beatty, executive assistant to Vice President Streeter in Pittsburgh, has been transferred to New Kensington as superintendent of the Arnold plant.

Albert Shepherd, formerly foundry superintendent of the Battle Creek, Mich., plant of the Advance Rumely Co., LaPorte, Ind., has resigned that position to become foundry superintendent of the Star Foundry Co., Troy, O., in which he has assumed an interest. Mr. Shepherd served his apprenticeship in England at Lowerby Bridge, Yorkshire, in the machine tool and steam engine business. He left England for Canada 20 years ago and has been active in the foundry business both in the United States and Canada since that time. Mr. Shepherd was tendered a farewell banquet by the officials and foremen of the Advance Rumely plant before he left to accept his new position.

R. B. Pogue, American Brake Shoe & Foundry Co., has been appointed assistant chief engineer of that company. Mr. Pogue was born at May's Lick, Ky., in 1889. He attended Center college and the University of Kentucky, graduating from the latter in 1913 with a bachelor of science degree. He then entered the University of Illinois and graduated in 1915 with his masters degree. During the years 1915 and 1916 he was a special apprentice in the mechanical department of the Chicago, Rock Island & Pacific railroad. Since that time, he has been in the employ of the American Brake Shoe & Foundry Co., New York.

Edward R. Young, formerly research engineer for the Detroit Steel Castings Co., Detroit, has joined the staff of the Climax Molybdenum Co., 61 Broadway, New York, as metallurgical engineer. Mr. Young was graduated from the University of Michigan with a bachelors degree in chemical engineering in 1915. He received his degree as master of science in engineering in 1917 after a year of graduate work specializing in foundry research as holder of an industrial fellowship in metallurgy. He has been identified with the foundry industry for the past 10 years as research metallurgist, plant metallurgist, and

research engineer with the Detroit Steel Casting Co., Detroit. Mr. Young is a member of the American Society for Steel Treating, American Institute of Mechanical Engineers and the American Foundrymen's association. He has been active on the technical committees of the A. F. A. and is a member of the committees on tests and heat treatment of steel castings and is chairman of the sub-committee on core tests.

Die Casting Institute Discusses Problems

Twenty-seven interested representatives of die casting firms throughout the country attended the first quarterly meeting of the newly formed American Die Casting institute, Philadelphia, which was held at the Hotel Cleveland, Cleveland, on Oct. 5. The morning session was opened by Charles R. Murray, Barnhart Bros. & Spindler, Chicago, who is president of the institute. The opening discussion related to a survey of the die casting industry, pointing out the numerous problems encountered, and the aims of the institute to correct through co-operation of the member firms, the various faults now existing.

H. R. Rinehart, secretary, then presented a tabulated form showing the analysis of shank regulator handle production costs. Previously members of the institute had been supplied with a blueprint of the handle and asked to submit all cost figures on making 10,000 and 50,000 of these castings. Considerable variation in figures presented showed those attending that there was an urgent need for an accurate, uniform system of computing costs. Discussion of the figures presented resulted in the plan to present from time to time other cost analysis forms in which data presented by the members would be compared to the figures obtained from actual jobs in some plant.

A. H. Bergedick, Perfection Die Casting Corp., Cleveland, chairman of the committee on cost estimating forms, presented its report. He was followed by E. W. Dollin, Allied Die Casting Corp., Long Island City, N. Y., chairman of the contract committee. The report of the membership committee was presented by W. G. Newton, Newton Die Casting Corp., New Haven, Conn., chairman.

At the afternoon meeting Charles E. Adams, Cleveland Hardware Co., Cleveland, spoke on, "The General Business Situation and Its Relation to the Die Casting Industry." In his remarks Mr. Adams stated that success in any field is due to a vision of optimism and belief in ones product. He also pointed out the changing trends in business and the effect of the numerous mergers which have taken place. Some years ago there were a large number of automobile firms, but at the present time there only are about 30 possible customers in this field. He predicted that in a few years that there would be only five. Mr. Adams mentioned the large field for die castings and stated that he believed co-operation of the firms in the industry would be of inestimable value in breaking down barriers of distrust, and enabling die casters to solve their individual problems.

Benjamin Freeman, technical director, National Chromium Corp., New York, presented a paper on, "The Preparation of Castings for Plating," in which he said that the characteristics of a good plate were a beautiful surface, durability and thickness of the plate. Designers of castings can assist in obtaining better plating by omitting sharp corners, crevices, etc.

Charles Pack, consulting engineer, New York, discussed the work being carried out by the American Society for Testing Materials which will be of value to the die casting industry. Mr. Pack said that this work involves the testing of 80,000 test bars for chemical and physical properties, resistance to corrosion and X-ray examination. He also suggested that the institute consider ways and means for developing capable die and toolmakers to replace the older generation which is disappearing.

The American Die Casting institute was organized at the Union League club, Philadelphia, in June, 1929, and at present is composed of 22 member firms. These firms include: Parker, White Metal & Machine Co., Erie, Pa.; Phoenix Die Casting Co., Buffalo; Superior Die Casting Co., Cleveland; Latrobe Die Casting Co., Latrobe, Pa.; Barnhart Bros. & Spindler, Chicago; Bohn Aluminum & Brass Corp., Detroit; California Die Casting & Mfg. Co., Hollydale, Calif.; Newton Die Casting Corp., New Haven, Conn.; C. M. Grey Mfg. Co., East Orange, N. J.; Mt. Vernon Die Casting Corp., Mt. Vernon, N. Y.; Sterling Die Casting Co. Inc., Brooklyn, N. Y.; Perfection Die Casting Corp., Cleveland; Illinois Die Casting Co., Chicago; Republic Die Casting Co., New York; Precision Castings Co. Inc., Syracuse, N. Y.; General Die Casting Co., Reading, Pa.; Twin City Die Casting Co., Minneapolis; Krone Sebek Casting & Mfg. Co., Chicago; White Brass Casting Co., Chicago; Alemite Die Casting & Mfg. Co., Chicago; Badger Die Casting Co., Milwaukee, and Cleveland Hardware Co., Cleveland.

Officers of the institute are: Charles R. Murray, Barnhart Bros. & Spindler, Chicago, president; D. F. Fesler, Alemite Die Casting & Mfg. Co., Chicago, vice president; J. N. Pomeroy, General Die Casting Co., Reading, Pa., treasurer, and H. R. Rinehart, Philadelphia, secretary. The offices of the institute are 505 Arch Street, Philadelphia. Meetings are to be held quarterly, the next being scheduled for Chicago in the middle of January. Local group meetings also will be fostered.

Electrochemists Make Two Awards

Two awards were made for the first time by the American Electrochemical society at the meeting held Sept. 19 to 21 at Pittsburgh. The Edward Goodrich Acheson gold medal and $1000 prize was awarded to Dr. Acheson in recognition of his noted work in graphite and carborundum. Dr. Francis C. Frary, president of the society, stated that it was the opinion of the group that Dr. Acheson merited the award regardless of the fact that he was its donor. This award, created through a fund established with the society by Dr. Acheson, will be made once in two years to an individual for important work in connection with electrochemistry, electrometallurgy or electrothermics or for distinguished services rendered to the society. Dr. Edward Sanigar of Sheffield, England, was awarded the Edward Weston fellowship in electrochemistry for his research work in electroplating. This fellowship was created recently by Dr. Edward Weston, president of the Weston Electrical Instrument Co., Newark, N. J., through a fund, and Dr. Sanigar is the first recipient. The fellowship of $1000 will be awarded by the society once a year to a candidate showing a marked capacity in carrying out research work in electrical chemistry.

Chicago Group Meets

Discussion of foundry problems by several guests and members featured the meeting of the Chicago Foundrymen's club, Thursday evening, Oct. 3, in the City club, Chicago. Speakers were David G. Anderson, Western Electric Co., Chicago, past president of the club, W. B. George, Sloan Valve Co., and L. E. Gilmore, Crane Co., Chicago. H. P. Evans, Pettibone Mulliken Co., president of the club, led the discussion. The address of the scheduled speaker, Dan M. Avey, editor of THE FOUNDRY, was postponed until a later meeting.

Obituary

Jacob Tyrowski, superintendent of the McCarthy Foundry Co., Chicago, died recently of pneumonia. He was a director of the Metropolitan State Bank and an executive of several building and loan associations.

David Clay Wasson, 61, for many years general foreman of the Harrisburg Foundry & Machine Works, Harrisburg, Pa., died recently.

Owen S. Wright, 63 years old, for the past 23 years local purchasing agent at the Indianapolis plant of the National Malleable & Steel Castings Co., died at his home following an illness of seven weeks. Mr. Wright started with the company in 1887 as office boy and had been in their employ continuously since that time, occupying various important positions.

Joseph E. Huston, 67 years old, secretary and treasurer of the Connersville Blower Co., Connersville, Ind., since it was founded in 1893, died Sept. 22 at his residence in that city following a brief illness. He was born at West Alexandria, O., Dec. 24, 1862, and obtained his higher education at Ohio States university. He located in Connersville in May, 1888, and became affiliated with the late L. T. Bower in the Connersville Buggy Co. Five years later he was associated with John T. Wilkin in founding the Connersville Blower Co.

James J. Carey, president of the Capital Castings Co., Lansing, Mich., died Oct. 1 following injuries received in an automobile accident. He was a member of the firm of Gerson & Carey and a former president of the Columbian National Fire Insurance Co.

George W. Gilbert, vice president, A. Gilbert & Sons Brass Foundry Co., St. Louis, died at St. Louis recently at an age of 58 years. He was born in St. Louis and soon after his graduation from high school, entered the employ of his father, A. Gilbert, founder of the company.

Harry F. Bayley, 62, for many years associated with the foundry and structural steel industry in Milwaukee, died recently. He formerly was president of Wm. Bayley & Sons, gray iron founders, established by his father. Later he organized and became president of the Bayley Structural Iron Co. He retired two years ago because of ill health.

H. Van Aarst, president of the Dutch Foundry Owner's association, the Dutch foundry technical association, and one of the delegates from Holland to the Third International Foundrymen's congress, died Sept. 3. He was 64 years of age. Mr. Van Aarst was one of the well known foundrymen of Western Europe and contributed many papers on foundry practice, one of which was presented at the recent international congress.

Jay C. McLauchlan, 55, partner in the firm of Pickands, Mather & Co., Cleveland, died at his residence in that city Oct. 8, after an extended illness. He was born in Cleveland March 12, 1874. He attended University school and was graduated from Yale university in 1898 with an A. B. degree. In the fall of that year he located in Detroit, becoming affiliated with F. A. Goodrich & Co. sales agents as a salesman of steel products. In 1903 he became identified with Pickands, Mather & Co. as sales manager at Detroit where he also represented the Lackawanna Steel Co. He was transferred to the Cleveland office of Pickands Mather & Co. in July, 1917, and was admitted to the firm as partner Jan. 1, 1918. As chief of the pig iron division, war industries board, Washington, Mr. McLauchlan accomplished much in the distribution of pig iron for World war purposes. Mr. McLauchlan also was a director of the Central Alloy Steel Corp., Massillon, O.; vice president and director of the Toledo Furnace Co., Toledo, O.; and vice president and director of the Perry Iron Co., Erie, Pa. He was a member of the American Iron and Steel institute.

Describes Core Ovens

Gehnrich Oven Co. Inc., Long Island City, N. Y., recently issued a bulletin on the uses of its ovens for core baking, mold drying, drying pasted cores, blacking, etc. The booklet contains information explaining the advantages of insulated steel ovens that the company manufactures. Each part of the ovens is described in detail including the walls, insulation, casing, binding sections, doors, ventilation and recirculation. The subject of heating also is discussed briefly. Some space is devoted to loading methods. The remainder of the booklet contains illustrations showing the various types of ovens that the company manufactures in typical installations.

The bureau of mines recently published a bulletin entitled, "Inflammability of Mixed Gases" giving data on mixtures of methane, hydrogen, carbon monoxide, etc. Copies of this bulletin may be obtained from the government printing office, Washington, for 10 cents.

Federal Foundry Supply Issues Catalog

Federal Foundry Supply Co., Cleveland, recently has issued a 485-page catalog on the various foundry supplies carried by the company. The first part of the book is devoted to descriptions of core compounds and core washes, fluxes, plumbago and to mixtures for different uses of the products in various type foundries. Cupola linings, natural abrasives, steel shot, graphite, roof cement are other materials discussed. The next section contains information of value on sand testing equipment. The following division describes many miscellaneous foundry supplies such as brushes, dust bags, bellows, screens, mallets, buckets, baskets, etc. Chaplets are included in the next section together with other items used in foundries, such as vibrators, ladles, flasks, etc. Sand mixers, furnaces, core making machines, hoists, molding machines, blowers, cupolas and many of the other items of large proportions compose the latter part of the book.

NewEnglandFoundrymen Hold October Meeting

The October meeting of the New England Foundrymen's association was held Oct. 9, at the Exchange club, Boston. The speaker of the evening was F. D. Campbell, chief engineer, Eastern Steel Castings Co., Newark, N. J. He spoke on the application of labor saving equipment, production methods, wage incentives, etc., to cutting of costs in the jobbing foundry. Many of the points brought out in the talk were illustrated by lantern slides.

Heads Committee on Iron Alloys

Dr. George B. Waterhouse, professor of metallurgy, Massachusetts Institute of Technology, Cambridge, Mass., will head the iron alloys committee of the Engineering foundation, according to H. Hobart Porter, president of the American Water Works & Electric Co., chairman of the foundation. With the co-operation of industries, engineering societies, universities, and the United States government, the committee will inaugurate a program of co-operative research vital to the progress of American iron and steel industry. The initial stage of the research will require 5 years and cost $150,000. It is planned to de-

velop it as an international enterprise, co-ordinating researches in ferrous metallurgy, the most important of which are going on in America, England and Germany.

Other members of the committee, which will at once begin a critical review of all available literature in English and other languages, resulting in a series of monographs and manuals, were named as follows: Dr. George K. Burgess, director of the United States bureau of standards, Louis Jordan of the same bureau, alternate; Scott Turner, director of the United States bureau of mines, Dr. Charles H. Herty Jr., alternate; R. E. Kennedy, technical secretary of the American Foundrymen's association; Dr. H. W. Gillett, director of the Battelle Memorial institute; Dr. Bradley Stoughton, director of the metallurgical engineering department of Lehigh university; Jerome Strauss, chief research engineer of the Vanadium Corp. of America; T. H. Wickenden, metallurgical engineer of the International Nickel Co.; Dr. John A. Mathews, vice president, Crucible Steel Co. of America.

The iron alloys committee will work in co-operation with the American Institute of Mining and Metallurgical Engineers, American Society of Mechanical Engineers, American Society of Civil Engineers, American Institute of Electrical Engineers, American Iron and Steel Institute, Society of Automotive Engineers, American Society for Steel Treating, American Society for Testing Materials, United States bureau of standards, United States bureau of mines, numerous corporations in the metallurgical industries and several universities. There are encouraging indications that foreign co-operation also may be arranged.

Will Meet in Paris

The eighth foundry congress organized by the French foundry association will be held on Friday and Saturday, Oct. 25 and 26, at the Ecole Nationale d'Arts et Metiers, Paris, under the patronage of the government department for technical education. The congress will be formally opened by E. Labbe, general director of technical education.

The following papers will be presented: "Production of High-Duty Cast Iron In the Electric Furnace," exchange paper of the Czechoslovak technical association, by A. Valenta, manager of the foundries of the Skoda works; "Alloys Which Are at Present Utilized in Great Britain," exchange paper of the Institute of British Foundrymen, presented by H. Turner, University of Birmingham; "A Few Shop Kinks Used In the Making of Molds for Molding Machines," by G. Toussaint, Haybes-sur-Meuse, Ardennes; "The Casting of Parts for Agricultural Machinery," exchange paper of the American Foundrymen's association, by H. Bornstein, chief metallurgist, Deere Co., Moline, Ill.; "The Shearing Test," presented by the committee on foundry testing of the Belgian foundry association; "About Tests For Cast Iron," by A. Le Thomas and M. Bois; "The Agitation of Cast Iron," by F. Girardet, St. Die, Vosges; "Scientific Researches and Metallurgy—Results To Be Applied In Cast Iron Foundries," by J. Pascal, Etablissements Diederichs, Bourgoin, Isere; "Changes In Cast Iron At High Temperatures," by A. Le Thomas; "Values Of the Modulus of Elasticity of Pearlitic Cast Irons," by M. de Leiris, Genie Maritime, Indret; "A Contribution To Foundry Organization," by G. Rivoire; "Special Steel Castings—Their Utilization For Valves Subject To High Temperatures," by J. Galibourg, and "Cast Irons Resistant To Heat and Corrosion," by A. Ballay.

A banquet, followed by a concert and dance, will be held at the Hotel Lutetia, Paris, and the minister of public instruction will preside.

Studies Safety in Foundry Industry

PLANS to further safety work in industry occupied the attention of numerous groups at the eighteenth annual safety congress, directed by the National Safety council, at the Stevens hotel, Chicago, Sept. 30 to Oct. 4. In nearly all of the sessions of the 27 industrial safety divisions, the framework for greater expansion of the safety movement was outlined. Exceeding previous meetings, the attendance at the congress was between 6000 and 7000, and an unusually large safety exhibit was held in connection. The congress was divided into 125 sessions, with more than 300 speakers.

Prizes in the iron and steel safety contest, sponsored for the first time by the metals section, were awarded to the Midvale Co., Nicetown, Philadelphia, in the A group of plants with 1000 or more employes, and to the Haynes Stellite Co., Kokomo, Ind., in the B group. These concerns were presented with safety shields, and certificates were awarded to the Corrigan-McKinney Steel Co., Cleveland, and the Columbus and Zanesville, O., units of the American Rolling Mill Co., in the A group, and the central works, American Rolling Mill Co., Middletown, O., and Driver-Harris Co., Harrison, N. J., in the B group.

Foundries were urged to intensify their safety work in a report of the foundry research committee given by F. G. Bennett, safety director, Buckeye Steel Castings Co., Columbus, O. The report emphasized the fact that the trend of the foundry industry is toward greater accident prevention, comparable with others of the iron and steel groups. The report described the steps leading to the safety committee of the American Foundrymen's association.

"A survey of the foundry industry, made by THE FOUNDRY, shows 5609 foundries in the United States, and 501 in Canada at the close of 1928," said the report. "We have 241 foundry members in the National Safety council, of which number 137 reported their statistics to our office last year. Dr. Lucien W. Cheney, of the bureau of labor statistics, United States department of labor, says he receives reports now from 85 per cent of the foundries. It is a difficult task to segregate the foundries into classes with respect to numbers of employes of types, unless a larger volume of statistics is supplied. The committee recommends that this work be continued. We have in mind to enlarge the committee by the selection of representative foundry members, and to hold a conference in Chicago soon after the first of the year, to subdivide and further study the causes of accidents.

"In the meantime all plants are urged to intensify their safety work, to do all possible to enlarge the membership of foundries in this organization, and to use the National Safety council for advice, assistance and study on particular problems. It is clearly evidenced by the records of large plants that accidents can be reduced in the foundry industry to the same level as in other plants.

A summary of comparable foundry safety statistics of 1926 and 1928 showed that the gray iron, steel, and foundries with machine shops had a decrease in accident frequency rates ranging from minus 17 to minus 28.

In a paper on "Procedure Control in Cutting and Welding," prepared

by H. S. Smith, consulting engineer, Union Carbide & Carbon Corp., New York, it was pointed out that it may become necessary for persons operating cutting and welding equipment to be licensed or have a permit, particularly in important work where strength of the part or structure is dependent upon the strength of the welding. It was emphasized in the paper that welding and cutting should not be carried on in the vicinity of readily combustible materials, and that wooden floors should always be protected with fire-proofing material, as in many cases the floors are saturated with oil.

More varied and numerous types of industrial safety and accident prevention equipment were displayed in the exposition than ever before at a similar meeting. Nearly 125 equipment manufacturers were represented, the exhibit touching nearly every line of the metal working field.

As usual, a large portion of the booths was devoted to the display of safety clothing and shoes. These exhibits included Safety Clothing Co., Cleveland; Surety Manufacturing Co., Chicago; Joseph M. Herman Shoe Co., Boston; Holcomb Safety Garment Co., Chicago; Lima, Cord Sole & Heel Co., Lima, O.; Lehigh Safety Shoe Co., Allentown, Pa., and a number of others. Des Moines Foundry & Machine Co., Des Moines, Ia., exhibited trucks for handling barrels and steel drums, and lifting devices. American Abrasive Metals Co., New York, displayed stair treads, thresholds and floor plates.

What the Foundries Are Doing

Reflecting the Activities of the Gray Iron, Malleable, Steel and Brass Shops

North Bend Iron Works, North Bend, Oreg., recently damaged by fire will be rebuilt immediately. Estimated loss was about $25,000.

Florence Pipe Foundry & Machine Co., Florence, N. J., has plans for building a 1-story foundry addition. (Noted Oct. 1.)

The General Electric Co., Schenectady, N. Y., is receiving bids for the construction of a foundry at its Erie, Pa., plant.

Logansport Radiator Equipment Co., Logansport, Ind., recently suffered a $2000 damage to its foundry by fire.

Wehrie Co., Newark, O., manufacturer of stoves and safes, has construction under way of five steel plant buildings.

Michaels Art Bronze Co., Court avenue, Covington, Ky., awarded a contract for a brick addition to B. T. Wisenall.

Oakley Valve & Foundry Co., Newark, N. J., has been incorporated with 5000 shares of common stock, by Earl Pollack, Elizabeth, N. J.

Birmingham Stove & Range Co., Tennessee pike, Birmingham, Ala., has plans for enlarging its plant.

Athens Stove Works, Athens, Tenn., has plans for doubling its capacity, probably next year. C. L. Williams is general manager.

Aluminum Industries, Inc., Cincinnati, reports excellent business in all divisions including the sand and permanent mold departments.

Chamber of commerce, Mauch Chunk, Pa., is encouraging efforts to establish a machine shop and foundry. Capital is being raised through public subscription. Estimated cost $30,000.

Industrial Electric & Machine Co., 507 East Russell street, High Point, N. C., care C. E. Kellam, plans to construct a foundry on Park street.

Wellington Foundry Co., Wellington, O., reports business good and that it is running a night shift to keep up production. Sam Hummel is superintendent.

Titusville Iron Works, Titusville, Pa., awarded the contract for a one and 2-story foundry addition to the Austin Co., 16112 Euclid avenue, Cleveland. Estimated cost is about $200,000.

Charles E. Larson, 2645 North Keeler avenue, Chicago, has plans for the construction of a 1-story foundry addition estimated to cost about $20,000.

Specialty Brass Corp., Lake Shore road, Kenosha, Wis., care C. M. Anderson, contemplates construction of a plant addition. Plans are private.

Baldwin Locomotive Works will acquire the Southwark Foundry & Machine Co., through an exchange of 43,000 shares of common stock. This business will be carried on at Baldwin's Eddystone, Pa. plant as a separate company with present officers and under the name of the Baldwin Southwark Co.

Newman Mfg. Co., Norwood, Cincinnati, has been awarded contract to install about $7000 worth of bronze work in the new Chicago store of A. Sulka & Co., stylists, of London and New York.

Bendix Aviation Corp., South Bend, Ind., a subsidiary of the Bendix Brake Corp., has plans for the construction of several plant buildings, an administration building and a foundry. Approximately $1,000,000 will be expended.

Inland Mfg. Co., Coleman street, Dayton, O., subsidiary of General Motors Corp., Detroit, manufacturer of steering wheels and automobile parts, has awarded contract for a plant addition to Hillsmith & Co. (Noted Sept. 15.)

L. C. Hirsheimer Inc., La Crosse, Wis., manufacturer of gray iron castings has the first unit of a new plant under consideration. It will be 80 x 180 feet and will cost approximately $50,000.

Central Tube Co. Inc., Pittsburgh, has been incorporated with 100 shares of no par stock to manufacture iron, steel, pipe, castings, etc. Robert W. Eiler, 5636 Callowhill street, Pittsburgh, is treasurer.

Levering Bros. Inc., 200 Key highway, Baltimore, soon will ask bids on the general contract for the construction of a one and two-story branch plant at Hanover, Pa. The new buildings and equipment will cost about $100,000.

Premier Foundry Co., North Bergen, N. J., has moved to 316 Bergen turnpike, Little Ferry, N. J. The company operates a nonferrous foundry 40 x 100 feet and a gray iron foundry, 25 x 100 feet. It also does plating work.

Sparta Foundry Co., Sparta, Mich., awarded contract for the construction of a 1-story foundry addition to Lenger & Kool, 1812 Granville avenue southwest, Grand Rapids, Mich. (Noted July 15.)

Locomotive Finished Material Co., Atchinson, Kans., will soon start construction of a foundry addition, 125 x 400 feet. The building will be equipped with two cranes, one 30-ton capacity and one 10-ton.

Fairmont Mining Machinery Co., Tenth and Belt streets, Fairmont, W. Va., plans to spend approximately $100,000 for plant improvements, including additional machinery for the machine shop and a foundry addition.

Central Pattern Works Inc., Indianapolis, has been incorporated with 1000 shares of no par stock to manufacture wood and metal patterns. Mifflin K. Hunter, 7901 East Washington street, is one of the incorporators.

Plainville Casting Co., Plainville, Conn., has awarded a general contract to the Torrington Building Co., Torrington, Conn., for a one-story foundry. The building and equipment will cost about $20,000.

Welded Alloys, Inc., New York, subsidiary of the Industrial Alloy Products Inc., which recently purchased the Titan Steel plant at Newark, N. J., will equip a foundry at the Titan plant for the production of stainless and alloy steel castings.

National Foundry & Furnace Co., Dayton, O., has purchased the former American Radiator Co. plant on West Main street, Springfield, O., and will operate it for the production of gray iron castings, necessitated by increased business.

Soultz Brass Foundry Co., 2439 West Eleventh street, Marion, Ind., has started construction of a 1-story building, 50 x 120 feet, which will be used as a gray iron foundry. A cupola with a capacity of six to seven tons per hour will be installed.

Wisconsin Foundries Inc., Green Bay, Wis., has purchased the Helgerson foundry property at Green Bay, formerly used for making steel castings. The manufacture of gray iron and steel castings is contemplated by the new owners.

Texas Machine & Foundry Co., 636 Rigsby street, San Antonio, Tex., is building an addition to its machine shop, 35 x 150 feet. A foundry building will also be constructed 35 x 160 feet, with a wing 35 x 50 feet. Equipment has been partly purchased. (Noted Sept. 15.)

Western Foundries Ltd., Lethbridge, Alta., has started work on the erection of a plant for the manufacture of highway machinery, oil and mine drilling equipment, cast iron water pipe, brass and bronze castings, etc. (Noted Sept. 15.)

Crucible Steel Castings Co., Milwaukee, is pushing construction work on two additions to its plant at 1284 Fifteenth avenue. One addition will be 31 x 129 feet and the other 31 x 80 feet. The work is being directed by Albert Pergande, consulting engineer, Milwaukee Bridge Co.

United Brass & Aluminum Mfg. Co., Port Huron, Mich., will rebuild the portion of its foundry recently damaged by fire. Equipment to be purchased will include one or more core ovens with core racks and core carrying equipment, also core making machines. (Noted Oct. 1.)

Allen Mfg. Co., Nashville, Tenn., manufacturer of stoves, ranges, etc., is contemplating the construction of a new plant at Franklin, Tenn. A site, 150 x 1200 feet, is under consideration. The new buildings and equipment are estimated to cost more than $200,000.